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Original Article

Atelectasis and Related Risk Factors After Congenital Heart Disease Surgery

Hasan Allah Sadeghi[1], MD; Reza Ahmad Pour[2], MD; Akbar Nikpajouh[1], MD; Mohamad Amin Shahrbaf[3]*, MD; Sarina Sadeghi[4], MD

ABSTRACT

Background: Pulmonary morbidity is a common complication of cardiac surgery, and the most common type of morbidity is atelectasis. The risk factors related to pulmonary morbidities and atelectasis have been previously explored in coronary artery bypass graft and valvular surgery. In this study, we sought to determine the risk factors related to atelectasis after adult congenital heart disease surgery (ACHDS).

Methods: This cross-sectional study was conducted on 43 patients (mean=36.3 and SD=16.37) who underwent ACHDS. The risk factors related to atelectasis were identified using a questionnaire which contained demographic factors, types of CHD, underlying diseases, and the length of postoperative stay in bed. The collected data were subsequently analyzed with SPSS.

Results: Of the 43 patients, only 3 (7%) had atelectasis after ACHDS. The tetralogy of Fallot surgery and delayed postoperative ambulation (>24 h) had a *P* value of 0.027 and 0.000, respectively. The other factors had *P* values higher than 0.05 and were, thus, not related to atelectasis.

Conclusions: The tetralogy of Fallot surgery and delayed postoperative ambulation (>24 h) were associated with the rate of atelectasis after ACHDS. ***(Iranian heart Journal 2018; 19(3): 15-19)***

KEYWORDS: Pulmonary atelectasis, Congenital heart defect, Cardiac surgical procedures, Thoracic surgery

[1] Rajaie Cardiovascular, Medical, and Research Center, Iran University of Medical Sciences, Tehran, I R Iran.
[2] Clinical Research Development Center, Loghman Hakim Hospital, Shahid Beheshti University of Medical Sciences, Tehran, I R Iran.
[3] Shahid Beheshti University of Medical Sciences, Tehran, I R Iran.
[4] Faculty of Medicine, Iran University of Medical Sciences, Tehran, I R Iran.

***Corresponding Author:** Mohamad Amin Shahrbaf, MD; Shahid Beheshti University of Medical sciences, Tehran, I R Iran.
Email: aminshahrbaf41@gmail.com **Tel:** 09189104127

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Pulmonary dysfunction was one of the most important complications in the early age of cardiac surgery. [1] Pulmonary complications are common after cardiac surgery and cause some degree of morbidity and mortality. [2, 3] The incidence of pulmonary dysfunction was reported to be 8% with a morbidity rate of 50% and a mortality rate of between 6.6% and 25% in previous studies. [4, 5] These complications consist of atelectasis, pleural effusion, pulmonary embolism, diaphragmatic paralysis, pneumonia, and acute

respiratory distress syndrome. [2, 6] These complications may occur 1 to 7 days after cardiac surgeries such as coronary artery bypass grafting and mitral valve replacement or after cardiopulmonary bypass, and atelectasis is a major problem among them with a maximum rate of 65%. [7-11] These pulmonary complications increase the cost and duration of hospitalization. [12] Congenital heart disease (CHD) is one of the most important issues in cardiology, with a reported prevalence rate of 1/84 in children and 1/245 in adults [13] and a mortality rate of 7.7%. [14] In the present study, we sought to determine the incidence of atelectasis in patients following adult congenital heart disease surgery (ACHDS) and the risk factors related to it.

METHODS

The study protocol was approved by the Research Department and the Ethics Committee of Rajaie Cardiovascular, Medical, and Research Center. A total of 43 patients who underwent ACHDS between June 2015 and November 2015 were recruited and followed up for the rate of atelectasis and the risk factors related to atelectasis following ACHDS. The exclusion criteria comprised canceled ACHDS (regardless of the cause) and emergency surgeries. All hospitalized patients who underwent ACHDS were studied using a questionnaire containing demographic characteristics, underlying diseases, cardiac risk factors, types of surgery, related factors like arrhythmias, length of postoperative stay in bed, and radiological findings. Also explored were the rates of blood or plasma transfusion after infection due to any cause, length of hospital stay, and rates of morbidity and mortality. [15] Atelectasis was confirmed based on the patients' chest X-ray or computerized tomographic scanning, if indicated, in the postoperative period. The collected data were entered into SPSS. For the comparison of the quantitative and qualitative data, the χ^2 test, the exact Fisher test, and the *t*-test or the Wilcoxon–Mann Whitney test were employed. A *P* value of equal to or less than 0.05 was considered statistically significant. Computer codes were used instead of the patients' names in order to observe ethical codes.

RESULTS

Age and Gender

In total, 43 patients who underwent ACHDS with any underlying factors were evaluated. From this total, 22 (51.16%) patients were female and 21 (48.84%) male. The mean age of the study population was 36.3 years (SD=16.37 y), and the minimum and maximum age of the patients was 16 and 67 years, respectively. The study patients were divided into 2 groups: those aged below 36 years (n=12 [27.91%]) and those aged above 36 years (n=31 [72.09%]).

History of Disease and Tobacco Use

From the 43 patients, 13 (30.2%) had a familial history of CHD, 10 (23.2%) had hypertension, 3 (7%) had diabetes, 3 (7%) were tobacco users (the highest rate of consumption=0.5 pack per day), and 7 (16.3%) had a history of heart disease.

Ejection Fraction

The patients' ejection fraction, obtained via echocardiography, ranged between 25% and 55% (mean=31% and SD=16.9%). The ejection fraction was below 31% in 31 (72%) patients.

Types of Surgery

The most common type of surgery among the patients was the closure of atrial septal defects (n=29 [67.4%]) and ventricular septal defects (n=13 [30.2%]). The other types of cardiac surgery were the patent foramen ovale closure (n=2 [4.7%]), the tetralogy of Fallot correction (n=4 [9.3%]), the patent ductus arteriosus closure (n=2 [4.7%]), and the transposition of the great arteries correction (n=2 [4.7%]). Four (9.3%) of these patients had both types of

surgery and 1 (2.32%) had the closure of both ventricular septal defect and patent ductus arteriosus.

Receiving Blood Products

From the 43 patients, 5 (11.6%) received packed cells at an average of 2 units and 4 (9.3%) received fresh frozen plasma at a mean of 3 units.

Prolonged Length of Stay in Bed

Only 2 (4.7%) patients from the 43 patients were out of bed 24 hours after surgery.

Rate of Mortality

Only 2 (4.7%) of the 43 patients died following ACHDS. The other patients (95.3%) were alive at the time of hospital discharge.

Rate of Atelectasis

Atelectasis was detected in 3 (7%) patients from the total of 43 patients after ACHDS.

DISCUSSION

Table 1 depicts the results of our statistical analyses on the study variables. Our results demonstrated that the 2 variables of the tetralogy of Fallot correction and delayed postoperative ambulation (>24 h) had a statistically significant association with the occurrence of atelectasis (P<0.05). Our comparisons of the mortality rate between the patients with atelectasis and those without it showed that one of the patients who died had atelectasis, and this morbidity had a significant statistical relationship with mortality after ACDHS (P<0.05). This finding should, however, be interpreted by taking into account the limited number of patients in the current study.

Some studies with the aid of computed tomography scanning have demonstrated that general anesthesia, which may be seen in almost all types of surgery, is responsible for pulmonary complications and hypoxia due to pulmonary shunting. [16-18] Among our 43 study patients, only 3 (7%) had atelectasis after ACHDS. The rate of atelectasis following cardiac surgery was reported to be 65% in a study. [11] The difference in our findings may be due to the number of patients recruited in our respective investigations and the fact that our statistical population was small. ACHDS is often done on patients with no other organ limitations, and these patients may be compromised due to older age and other comorbidities. There are several studies which have reported pulmonary morbidities after cardiac surgery. [1, 4, 5, 7-9] We, however, explored this complication in the field of ACHDS. Patients' health status, types of anesthesia, types of cardiac surgery, patients' age, the body mass index, hypertension, smoking history, the duration of surgery, and underlying diseases such as diabetes and chronic obstructive pulmonary disease may have an impact on the incidence of postoperative pulmonary complications. [5, 19-22] Concerning ACHDS, we found that the type of surgery and delayed postoperative ambulation might be related to the rate of postoperative atelectasis.

Our findings also indicated the impact of age and underlying diseases such as diabetes and pulmonary disease, which have been previously reported as well. [20-22] We, nevertheless, found no correlation with these factors in our study.

Table 1. Results of the statistical analysis of the variables

Variable		Atelectasis		*P*
		Yes	No	
Gender	Male	2	19	0.489
	Female	1	21	
Atrial septal defect	No	1	13	0.976
	Yes	2	27	
Ventricular septal defect (VSD)	No	2	28	0.903
	Yes	1	12	
Patent foramen ovale	No	3	38	0.692
	Yes	0	2	
Tetralogy of Fallot	No	1	38	**0.000**
	Yes	2	2	
Patent ductus arteriosus (PDA)	No	3	38	0.692
	Yes	0	2	
Transposition of the great arteries	No	3	38	0.692
	Yes	0	2	
Atrioventricular septal defect	No	2	37	0.137
	Yes	1	3	
VSD-PDA	No	3	39	0.822
	Yes	0	1	
History of cardiac disease	No	3	33	0.428
	Yes	0	7	
History of pulmonary disease	No	3	36	0.565
	Yes	0	4	
Diabetes	No	3	37	0.623
	Yes	0	3	
Age	>36	2	29	0.305
	<36	1	11	
Ejection fraction (%)	>31	0	12	0.173
	<31	1	30	
Delayed postoperative ambulation (>24 h)	No	2	39	**0.027**
	Yes	1	1	
Hypertension	No	3	30	0.323
	Yes	0	10	
Familial history of congenital heart disease	No	2	28	0.154
	Yes	1	12	
History of tobacco use	No	3	37	0.063
	Yes	0	3	
Infusion of blood products	No	3	35	0.565
	Yes	0	5	
Infusion of plasma	No	3	38	0.720
	Yes	0	2	

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