

## Clinical profile and success in patient extubation after cardiac surgery

### Perfil clínico e sucesso na extubação de pacientes pós cirurgia cardíaca

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**RESUMO | INTRODUÇÃO:** Pacientes submetidos à cirurgia cardíaca necessitam de ventilação mecânica invasiva após o procedimento cirúrgico. A extubação no pós-operatório quando bem-sucedida, está relacionada com menor tempo de internação, redução de custos e recursos utilizados e diminuição das taxas de morbimortalidade. **OBJETIVO:** Identificar o perfil e o número de reintubações de pacientes submetidos a cirurgias cardíacas. **MATERIAIS E MÉTODOS:** Estudo quantitativo, transversal retrospectivo, com coleta de dados secundários obtidos de prontuários eletrônicos em um Hospital Municipal da Região Metropolitana de Porto Alegre/RS. Foram incluídos 57 prontuários de pacientes submetidos a cirurgia cardíaca entre janeiro e dezembro de 2017 e excluídos aqueles com idade menor que 18 anos e/ou extubados previamente no bloco cirúrgico. **RESULTADOS:** A amostra foi composta por 22 mulheres (38,6%) e 35 homens (61,4%), com média de idade 61,60±12,33 anos. Foram realizadas 37 cirurgias de revascularização do miocárdio (64,9%), sendo sete destas associadas a troca valvar. Em relação ao desmame, 96,5% dos pacientes obtiveram sucesso na extubação, 77,2% ficaram um período menor que 24 horas em ventilação mecânica invasiva e 15,8% foram reintubados. A média de tempo de internação hospitalar foi de 22,77±17 dias e na Unidade de Terapia Intensiva de 8,53 dias, sendo que 80,7% dos pacientes tiveram alta desta unidade. **CONCLUSÃO:** A caracterização clínica, sociodemográfica e cirúrgica dos pacientes submetidos a cirurgia cardíaca se assemelha aos achados na literatura, uma prevalência de pacientes idosos e do sexo masculino e baixa taxa de reintubação.

**PALAVRAS-CHAVE:** Desmame. Extubação. Procedimentos cirúrgicos cardiovasculares. Circulação extracorpórea. Unidades de Terapia Intensiva.

**ABSTRACT | INTRODUCTION:** Patients undergoing cardiac surgery require invasive mechanical ventilation after the surgical procedure. Postoperative extubation, when successful, is related to shorter hospital stay, reduced costs and resources used and decreased morbidity and mortality rates. **AIM:** To identify the profile and number of reintubations of patients undergoing cardiac surgery. **MATERIALS AND METHODS:** Quantitative, cross-sectional retrospective study, with collection of secondary data obtained from electronic medical records at a Municipal Hospital in the Metropolitan Region of Porto Alegre/RS. Were included 57 medical records of patients who underwent cardiac surgery between January and December 2017 and excluded those under the age of 18 and / or previously extubated in the surgery block. **RESULTS:** The sample consisted of 22 women (38.6%) and 35 men (61.4%), with a mean age of 61.60 ± 12.33 years. 37 myocardial revascularization surgeries were performed (64.9%), seven of which were associated with valve replacement. Regarding weaning, 96.5% of the patients were successful in extubation, 77.2% spent less than 24 hours on invasive mechanical ventilation and 15.8% were reintubated. The average length of hospital internment was 22.77 ± 17 days and in the Intensive Care Unit was 8.53 days, being that 80.7% of patients discharged from this unit. **CONCLUSION:** The clinical, sociodemographic and surgical characterization of patients undergoing cardiac surgery is similar to the findings in the literature, a prevalence of elderly and male patients and a low rate of reintubation.

**KEYWORDS:** Weaning. Airway extubation. Cardiovascular surgical procedures. Extracorporeal circulation. Intensive Care Units.

## Introduction

The number of cardiac surgical procedures has increased in recent decades, and among the most common are Myocardial Revascularization (MR) and the correction of valve diseases. The indication for the surgical process varies according to the associated comorbidities, age and severity of clinical manifestations<sup>1,2,3</sup>. In 2018, in Brazil, around 23 thousand Cardiac Surgeries (CS) were performed, comprising valve repair and replacement and myocardial revascularization, among which more than a thousand deaths were recorded<sup>4</sup>.

This procedure is complex in which the patient is submitted to general anesthesia and postoperative recovery in the Intensive Care Unit (ICU), since it can trigger cognitive, ventilatory and hemodynamic changes, thus requiring monitoring and continuous care. In addition, the procedure involves altering several physiological and mechanical mechanisms, also compromising lung function and causing a decrease in respiratory muscle strength, which imposes great organic and psychological stress, and consequent delay in the recovery of these patients<sup>2,3</sup>.

Cardiac surgery is classified into three types: brokerage, reconstruction and substitution. Corrective surgeries promote the reversal of pathological changes in the ductus arteriosus and atrial and ventricular septa; reconstructive surgeries are aimed at MR or heart valve repair (aortic, mitral or tricuspid); and substitutes include valve changes and transplants. Among them, the most common are reconstructive ones, especially MR<sup>5,6</sup>.

In the postoperative period of CS, the patient remains on Invasive Mechanical Ventilation (IMV) for a few hours and should be extubated as soon as the hemodynamic condition and anesthetic awakening stabilize. There is a proposal for tracheal extubation in up to eight hours or even in the operating room, but the risk of hypothermia, bleeding and hemodynamic instability and respiratory complications are greater than the benefits<sup>7,8</sup>. It is considered successful in extubation when the patient remains clinically stable

on spontaneous ventilation for a period longer than 48 hours. Successful extubation is related to shorter hospital stays, reduced costs and resources used and decreased morbidity and mortality rates<sup>2,9,10</sup>.

However, it is important to identify possible failures in extubation in order to promote better care, minimize functional losses and disabilities, reverse or mitigate complications, assist in the management of resources and costs of hospitalization, in addition to optimizing the approach to these patients.

Knowing that the incidence of cardiovascular diseases and the number of cardiac procedures increases worldwide every year, it is necessary to further studies that propose protocols for weaning and extubation after cardiac surgery, with the objective of optimizing the prognosis and reducing the time hospitalization, in addition to developing strategies and techniques, reducing morbidity and mortality, hospitalization rate and the quality of life of this population.

Thus, this study was developed with the aim identify the profile and number of reintubations of patients undergoing cardiac surgery.

## Method

A retrospective, observational, descriptive quantitative study was carried out, using secondary data obtained from the electronic medical record system of a Municipal Hospital in the Metropolitan Region of Porto Alegre / RS. The population was delimited in patients who underwent cardiac surgery and who had their postoperative recovery in the Adult ICU. All patients hospitalized from January to December 2017, aged 18 years or over, of both genders, who underwent cardiac surgical intervention and who needed IMV were included. Patients extubated in the operating room were excluded before being referred to the ICU.

This research followed resolution 466/12 of the National Health Council (NHC) and was approved by the Municipal Nucleus of Education in Collective Health (MNECH) and by the Ethics and Research Committee (ERC) under opinion no 87870318.9.0000.5348

The collection instrument included patient identification data (dates of admission, admission to the ICU and surgical procedure, age and sex), preoperative information (diagnosis, type of surgery - emergency or elective, pre-existing behaviors and comorbidities) , intraoperative information (type of surgical procedure, extracorporeal circulation times, aortic clamping and surgery, type of anesthesia and complications) and postoperative information (medications, mechanical ventilation times, use of drains and ICU stay) and hospital, complications of the immediate and late postoperative period, failure of extubation and the outcome).

Extubation was considered successful when there was no need for reintubation within 48 hours after removal of the artificial airway. Data analysis was performed using statistics with absolute frequencies (n), mean and standard deviation for the results found.

## Results

Were analyzed 57 electronic medical records between January and December 2017. The sample consisted of 22 women (38.6%) and 35 men (61.4%), with a mean age of  $61.60 \pm 12.33$  years , diagnosed mostly with Valvulopathy (33.3%) and Coronary Artery Disease (CAD) (28.1%). Myocardial revascularization surgeries made up 37 (64.9%) of the total surgeries, seven of which were associated with valve replacement. As for weaning from ventilatory support, 96.5% of patients were successful in extubation after surgery and 77.2% were less than 24 hours on IMV. Table 1 shows the clinical, demographic and surgical data of patients undergoing cardiac surgery.

All patients undergoing CS performed the procedure electively and with general anesthetic induction. Several comorbidities were found associated with the patients' clinical condition, with some having more than one comorbidity. These consisted of 41 (71.9%) cases with Systemic Arterial Hypertension (SAH) followed by 23 (40.3%) with Diabetes Mellitus (DM), 15 (26.3%) previous Acute Myocardial Infarction (AMI), 14 (24.6%) smoking, 12 (21%) dyslipidemia, seven (12.3%) Chronic Obstructive Pulmonary Disease (COPD), four

(7%) obesity, three (5.3%) Renal insufficiency (RI), three (5.3%) neoplasms and two (3.5%) alcoholism.

Of the 57 patients undergoing CS, nine (15.8%) needed to be reintubated at least once during the hospitalization period. Two reintubations were associated with the failure of extubation, one occurred in a patient undergoing MR, and the other in an MR associated with valve replacement, while the rest of the reintubations were due to complications acquired during hospitalization. A total of 80.7% of patients were discharged from the ICU and 19.3% died. Patients who underwent MR associated with valve replacement had high extracorporeal circulation times (CPB) and aortic clamping (CLAMP), these patients evolved with the need for reintubations and for death. The outcome, CPB and CLAMP duration and reintubation rates are described in Table 2.

All patients used the mediastinal drain, with 37 (64.9%) associated with the presence of a chest drain and five (8.8%) two chest drains. Regarding the complications presented by the patients, ten (17.5%) complications were found in the immediate postoperative period and 14 (24.6%) in the late postoperative period.

Among the complications of the immediate postoperative period, three (5.3%) complete Atrioventricular block (AV), three (5.3%) Cardiorespiratory Arrest (CRP), two (3.5%) Atrial Fibrillation (AF), one (1.7%) Pleural Effusion (PE) and one (1.7%) bleeding. In addition, 66.67% of patients needed Noradrenaline and 52.6% needed Nitroglycerin in the immediate postoperative period. In the late postoperative complications, there were four (7%) Acute Kidney Injury (AKI), three (5.3%) CRP, three (5.3%) Bronchopneumonia (BCP), three (5.3%) Acute breathing insufficiency (IRpA), three (5.3%) atelectasis, two (3.5%) infections, two (3.5%) pneumothorax, one (1.7%) AV, one (1.7%) PE, one (1.7%) hemopericardium, one (1.7%) bleeding, one (1.7%) AF, one (1.7%) empyema and one (1.7%) mesenteric ischemia.

**Table 1.** Clinical, demographic and surgical data of patients undergoing cardiac surgery between January and December 2017 (n = 57)

Variables	Mean/SD	N (%)
<b>Age (Years)</b>	61,60 ± 12,33	
<b>Genre</b>		
Male		35 (61,4)
Feminine		22 (38,6)
<b>Clinical diagnosis</b>		
CAD		16 (28,1)
AMI		5 (8,8)
Angina		2 (3,5)
Ischemic heart disease		9 (15,8)
Valve Insufficiency		2 (3,5)
Valvulopathy		19 (33,3)
Others		4 (7)
<b>Type of surgery</b>		
MR		30 (52,6)
Valve Exchange		19 (33,3)
Both		7 (12,3)
CIAC		1 (1,7)
<b>MV Duration</b>		
<24 hours		44 (77,2)
24 to 48 hours		7 (12,3)
> 72 hours		6 (10,5)
<b>Extubation</b>		
Success		55 (96,5)
Failure		2 (3,5)
<b>Time (days)</b>		
ICU admission	8,53 ± 8,08	
Drains	2,89 ± 2,69	
Hospital internment	22,77 ± 17,25	

**SD:** Standard Deviation; **N:** Number of patients; **CAD:** Coronary Artery Disease; **AMI:** Acute Myocardial Infarction; **Others:** Oatrium Secundum Interatrial Communication, Aortic Aneurysm, Chronic Heart Failure and Rheumatic Heart Disease; **MR:** Myocardial Revascularization; **Both:** MR associated with valve replacement; **CIAC:** Correction of Interatrial Communication; **MV:** Mechanical Ventilation; **ICU:** Intensive Care Unit; **Drains:** chest and/or mediastinum.

**Table 2.** Outcome, intraoperative characteristics and reintubation rates of patients undergoing cardiac surgery, 2017 (n = 57)

Variables	Outcome: N (%)		Duration: Mean/SD		Reintubation
	High	Death	CPB (minutes)	CLAMP (minutes)	N (%)
MR	27 (90)	3 (10)	65,80 ± 18,93	52,60 ± 16,42	4 (44,4)
Valve Exchange	16 (84,2)	3 (15,8)	82,95 ± 23,02	67,42 ± 20,39	1 (11,1)
Both	2 (28,6)	5 (71,4)	150 ± 56,11	110 ± 28,25	4 (44,4)
CIAC	1 (100)	0 (0)	36	24	0 (0)
Total	46 (80,7)	11 (19,3)	81,33 ± 64,09	38,07 ± 27,30	9 (15,8)

**N:** Number of patients; **SD:** Standard deviation; **CPB:** Extracorporeal Circulation; **CLAMP:** Clamping of the aorta; **MR:** Myocardial Revascularization; **Both:** MR associated with valve replacement; **CIAC:** Correction of Interatrial Communication.

## Discussion

The sample consisted predominantly of men, elderly and with an initial medical diagnosis of CAD. Most patients who underwent CS had MR as a prevalent procedure, in addition, they remained on IMV for less than 24 hours and progressed to extubation success, with hospital discharge as the main outcome.

In patients who undergo CS, diagnoses of Coronary Failure, Chronic Heart Failure and Valvulopathies are most commonly observed<sup>1</sup>. In the present study, there were similar results, with the majority of patients diagnosed with Vavulopathies followed by CAD.

In this series, there was a predominance of male and elderly patients who presented mainly as comorbidities SAH, DM and AMI. Strolischein et al.<sup>7</sup> also observed in their sample an audience composed mostly of men and aged 60 to 69 years. According to Werle, Steidl and Mancopes<sup>5</sup>, the rate of cardiac surgeries is higher in the elderly because this population has a higher incidence of cardiovascular diseases. In addition, the high rates of morbidity and mortality are related to associated comorbidities, such as DM and dyslipidemia, lower functional reserve and lean mass depletion in this population. Caldeira and Soares<sup>11</sup>, found SAH followed by DM, dyslipidemia and smoking as the most common clinical history. These authors also observed that 23.17% of the selected patients had AMI in the last 90 days before surgery.

All patients undergoing CS underwent general anesthesia. It is known that this type of anesthetic induction contributes to the depression of the respiratory center, causing the loss of the skeletal muscle contraction capacity and of the autonomous responses and consequent decrease in functional residual capacity (FRC), these factors induce the need for intubation and IMV<sup>12,13,14</sup>.

In the postoperative period of CS, the patient remains on IMV for a few hours, and must be extubated as soon as the hemodynamic condition and anesthetic effect are established, in order to reduce hospital stay, hospital costs and resources and morbidity and mortality rates<sup>2,7,8,9,10,15</sup>. The prolongation of IMV time entails imminent risks for the patient, and includes hemodynamic complications, lung injuries, pneumonia associated with mechanical ventilation, airway trauma, reduced strength and atrophy of the respiratory and peripheral muscles<sup>14,16,17</sup>.

Some factors are associated with prolonged IMV time, such as old age, female gender, CPB time, cardiac dysfunction and low cardiac output. When the extubation process occurs promptly, a reduction in postoperative pulmonary complications and a reduction in the length of stay in the ICU and hospital are triggered<sup>7,8</sup>. Corroborating with the current study, most patients have successfully evolved from extubation and, consequently, with less period of use of drains and ICU stay with the main outcome of hospital discharge. Cordeiro et al.<sup>18</sup> found in their study that all patients followed up had a successful extubation. The authors mentioned that ventilatory mechanics was not able to influence the duration of IMV and the length of stay in the ICU, however, they would attribute as causes of failure to withdraw invasive ventilatory support, the presence of cardiac dysfunction and prolonged CPB time.

The withdrawal of ventilatory support must be associated with a thorough evaluation of pulmonary mechanics in order to reduce the rates of failure in extubation, since reintubation causes deleterious effects to the respiratory and systemic systems, with the need to prolong the time of mechanical ventilation and consequent, hospitalization in the ICU and hospital, in addition to being closely linked to the high morbidity and mortality of patients<sup>16</sup>.

In the study, nine cases of reintubation were found, two of which were associated with failure in the process. The occurrences of reintubations were predominant in procedures in which MR was associated with valve replacement, which can also be seen to have a greater number of deaths. However, it cannot be said that there is a direct relationship between the rate of reintubations and the type of surgery performed, since most were associated with factors consistent with the length of hospital stay. For Shoji et al.<sup>10</sup>, patients undergoing valve replacement have a higher risk of reintubation, when compared to those undergoing MR. This occurrence is due to the preoperative impairment of pulmonary function, interfering with the worsening in the postoperative period with a decrease in lung compliance, which makes it difficult to accommodate the blood volume of the lungs after correction of the valve defect<sup>10</sup>.

Approximately 3 to 6% of patients require IMV for a period longer than 24 hours, due to factors such as: complexity of heart disease, previous lung diseases or other systemic problems<sup>14,19,20</sup>. According to the current study, most patients who underwent cardiac surgery were extubated briefly, that is, before completing 24 hours of IMV.

Cardiopulmonary bypass can cause decreased pulmonary compliance, pulmonary vascular hypertension and changes in capillary alveolar permeability due to the systemic inflammatory response resulting from blood contact with a non-endothelialized machine surface<sup>13</sup>. In addition, when related to prolonged time, it can lead to an increase in neurological, cognitive, respiratory and renal deficits. In a study that described the clinical profile of post-CS patients, it was identified that, among 100 (one hundred) medical records analyzed, those who had CPB time greater than 60 minutes had consequences at the cellular level<sup>1</sup>. In this series, there was a low rate of complications in the immediate and late postoperative period, the most common being CRP, AV and AKI for an average CPB of about 81 minutes.

According to the literature, the main postoperative complications are those related to respiratory function and hemodynamic instability, being determined

by high surgical complexity, long duration, surgical incision, degree of anesthetic induction, mechanical ventilation, use of chest drains, length of stay in CPB and preoperative status. As well as, the existence of previous diseases, especially systemic ones, in addition to old age and smoking<sup>12,14,21,22</sup>.

The presence of the pleural drain causes more trauma to the chest, reaching the intercostal muscles and the parietal pleura, resulting in changes in respiratory movements and mechanics, lung volumes, gas exchange and a deficit in the production of surfactant, increasing the patient's discomfort. The intercostal drain is more related to worsening lung function when compared to the insertion in the xiphoid region<sup>14</sup>. All patients in this study used the mediastinal drain, most of which was associated with the pleural. Supposing then, an increased risk of pulmonary complications, among which most observed in this study, were consistent with the presence of pleural effusion and atelectasis.

As limitations of the study, the small sample size and the absence of important information in the electronic medical records were identified, such as the total surgical and reperfusion time, as well as the completion of important scales to assess the patient's prognosis, denoting the importance of implanting an electronic medical record with a comprehensive database of surgical data involving the pre, intra and postoperative period for monitoring these patients. From the results obtained, it is suggested that future research be carried out, with a multicenter character, a larger sample size and data collection period.

## Conclusion

After analysis, there was a prevalence of male and elderly patients with previous comorbidities, the most prevalent being SAH and DM. Most patients who underwent CS had MR as a prevalent procedure, in addition, they remained on IMV for less than 24 hours and progressed to extubation success, with hospital discharge as the main outcome.

## Author contributions

Assis CR, Fortino CK, Saraiva CAS, Omizzollo S and Silva RE participated in the conception and design of the article; data collection, analysis and interpretation; final writing; critical review of the article and final approval of the version to be published. Frohlich LF participated in the critical review of the article and final approval of the version to be published.

## Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

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