ORIGINAL ARTICLE

Rev Bras Cir Cardiovasc 2012;27(4):520-8

Independent predictors of prolonged mechanical ventilation after coronary artery bypass surgery

Fatores preditores independentes de ventilação mecânica prolongada em pacientes submetidos à cirurgia de revascularização miocárdica

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DOI: 10.5935/1678-9741.20120093

RBCCV 44205-1418

Abstract

Objective: **To determine independent predictors of prolonged mechanical ventilation in patients undergoing coronary artery bypass graft surgery.**

Methods: **Data of patients undergoing coronary artery bypass graft surgery were included prospectively from July 2009 to July 2010. All data were input into an electronic database. The resulting cohort included a total of 2952 patients of which 77 remained more than 48 hours on mechanical ventilation. Patients were divided into two groups: 1) a prolonged ventilation group, needing mechanical ventilation for more than 48 hours and 2) not prolonged ventilation group, undergoing a successful extubation within 48 hours.**

Results: **After adjustment for confounding factors a multivariate analysis identified the following factors as independent predictors of prolonged mechanical ventilation: age (OR 1.06 95% CI 1.03 -1.09; *P* <0.001), chronic renal failure (OR 3.52 95% CI 1.84 - 6.74; *P* <0.001), chronic obstructive pulmonary disease (OR 2.65 95% CI 1.38 -5.09; *P* = 0.004), coronary artery bypass graft associated with other procedures (OR 3.33 95 % CI 1.89 - 5.58; *P* <0.001) and clamping time (OR 1.01 95% CI 1.00 -1.02; *P* = 0.018).**

Conclusion: **The identification of these predictors allows the development of preventive strategies that could reduce invasive ventilation time, since patients on prolonged mechanical ventilation present greater morbidity and mortality rates.**

Descriptors: **Myocardial revascularization. Respiration, artificial. Intensive care units.**

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Paper presented at the 67th Brazilian Congress of Cardiology - Recife, Brazil, from 14 to 17 September 2012.

Article submitted on August 31st, 2012
Article accepted on November 8th, 2012

Abbreviations, acronyms and symbols	
CPB	Cardiopulmonary Bypass
CABG	Coronary Artery Bypass Grafting
COPD	Chronic obstructive pulmonary disease
HF	Heart Failure
BMI	Body Mass Index
CRF	Chronic renal failure
STS	Society for Thoracic Surgeons
SUS	Unified Health System
ICU	Intensive Care Unit
MV	Mechanical ventilation

Resumo

Objetivo: **Determinar os fatores preditores independentes de ventilação mecânica prolongada em pacientes submetidos à cirurgia de revascularização miocárdica.**

Métodos: **Foram incluídos prospectivamente em um banco de dados eletrônico informações de pacientes submetidos ao procedimento de cirurgia de revascularização miocárdica no Hospital Beneficência Portuguesa de São Paulo, no período de julho de 2009 a julho de 2010. O total da amostra do estudo foi de 2952 pacientes, dos quais 77 permaneceram em ventilação mecânica por mais de 48 horas. Os pacientes foram divididos em dois grupos, baseados na duração da ventilação mecânica, o grupo com ventilação prolongada e o grupo sem ventilação prolongada.**

Resultados: **Após os ajustes dos fatores de confusão foi realizada análise multivariada, que identificou os seguintes fatores como preditores independentes de ventilação mecânica prolongada: idade (OR 1,06 IC 95% 1,03-1,09; *P*<0,001), insuficiência renal crônica (OR 3,52 IC 95% 1,84-6,74; *P*<0,001), doença pulmonar obstrutiva crônica (OR 2,65 IC 95% 1,38-5,09; *P*=0,004), cirurgia de revascularização miocárdica associada a outros procedimentos (OR 3,33 IC 95% 1,89-5,58; *P*<0,001) e tempo de pinçamento (OR 1,01 IC 95% 1,00-1,02; *P*=0,018).**

Conclusão: **A identificação desses fatores possibilita o desenvolvimento de estratégias preventivas que diminuam o tempo de ventilação invasiva, uma vez que os pacientes em ventilação mecânica prolongada apresentam maior morbidade e mortalidade.**

Descritores: **Revascularização miocárdica. Respiração artificial. Unidades de terapia intensiva.**

INTRODUCTION

The aging population is a worldwide phenomenon. Estimates suggest that the number of elderly in Brazil exceeds 30 million people over the next 20 years, which represent almost 13% of the population [1]. Coronary artery disease increases their frequency with age and, nowadays, is a highly prevalent condition worldwide population [2]. According Beaglehole [3], ischemic heart disease is the leading cause of death in developed countries, accounting for 30% of deaths per year. The treatment of this condition by coronary artery bypass graft (CABG) has significantly increased survival [4]. Moreover, it has been increasingly performed in patients with advanced age, which have more extensive coronary involvement, tortuous arteries more rigid and calcified, among other factors [5].

Since its first description by Favaloro [6] and Garrett et al. [7], the CABG has revolutionized the treatment of coronary disease and has become the surgical procedure of large most studied and performed the story. The development of research in this field gives great scientific foundations of CABG procedures, with the precise definition of its indications, intraoperative management and postoperative care, which optimizes their results too [8].

Continuous improvement and technological advancement as well as the high prevalence of coronary heart disease in the world, made the procedure took propulsion. Currently, they are made in Brazil, approximately 350 heart surgeries per million inhabitants per year, a figure that includes implants pacemakers and defibrillators. This rate is even lower than the United States, with 2,000 cardiac surgeries per million population per year, and the UK and Europe, with more than 900 heart surgeries per million inhabitants per year, which suggests the potential for future growth of these procedures in Brazil [8].

Despite major advances already achieved in CABGs, studies still show significant rates of postoperative complications, which increase the length of hospital stay, raise the costs and impact in higher mortality [9]. The identification of factors that may influence the clinical course of these patients can assist in surgical indication and prevent postoperative complications. In Brazil, the rate of mortality after cardiovascular surgery in hospitals affiliated to the Unified Health System (SUS) is approximately 8% [10]. In the United States of America, is around 4%, according to the Society for Thoracic Surgeons (STS) [11].

Pulmonary complications are the leading cause of morbidity and mortality in post-CABG. Factors such as anesthesia, surgical incision, cardiopulmonary bypass (CPB), ischemia time, surgical technique and drains may predispose the patient to the change in pulmonary function postoperatively. Furthermore, mechanical ventilation (MV) is a prolonged contributing factor to these complications [12].

Patients undergoing cardiac surgery are usually able to resume spontaneous ventilation as soon as they recover from anesthesia. However, about 2.6% to 22.7% of patients requiring prolonged MV [13]. Those who remain in MV postoperatively and unsuccessful removal of ventilatory support have more complications, such as respiratory infections, and increased mortality in the short and medium term, beyond the increased length of hospital stay and increased costs [14-16]. Therefore, knowledge of the predictors of prolonged MV in patients undergoing CABG is crucial to improve the management of these cases.

The aim of this study was to determine the independent predictors of prolonged MV in patients undergoing CABG.

METHODS

Were prospectively included in an electronic database, information for patients undergoing CABG in the Portuguese Beneficent Hospital of São Paulo, 18 years or older, from July 2009 to July 2010. This database contains data of 3010 patients undergoing CABG, which comprises 69.6% of the total surgeries performed in the period. This loss percentage inclusion of patients in the database occurred randomly, without preference for day, time, time, staff, surgeon or patient conditions.

The form of data collection presents 243 variables with data collected from all fourteen teams Institution of cardiac surgery. The team showed that contributed 81.4% of their patients included, while the team that offered fewer patients had 59.5% of their patients included in the database. All information was kept confidential, and the identity of the patients.

For the purpose of this study, we performed a retrospective review of this database. Mechanical ventilation was defined as prolonged invasive ventilation for more than 48 hours. The patients were divided into two groups based on the length of the MV, the prolonged ventilation group and the group without prolonged ventilation. We excluded 58 patients of the total bank because they died in a period of less than 48 hours. Therefore, the total study sample of 2952 patients, of which 77 remained on MV for more than 48 hours.

In this study, the following variables were selected from the database: age, sex, length of hospital stay, body mass index (BMI), comorbidities, indication for surgery (elective or emergency), operative time, CPB time, length of stay in the intensive care unit (ICU) acquired comorbidities after surgery and operative complications and postoperative.

The study was approved by the Ethics Committee of the Portuguese Beneficent Hospital of São Paulo, in the opinion of number 657-10.

Statistical considerations

Initially, all variables were analyzed descriptively. For quantitative variables, this analysis was done by observing the minimum and maximum values, and the calculation of means and standard deviations. For qualitative variables were calculated absolute and relative frequencies.

The Student t test was used to compare means between two groups. When the assumption of normality of the data was rejected, we used the nonparametric Mann-Whitney [17].

To test the homogeneity between the proportions we used the chi-square test or Fisher's exact test (when expected frequencies were less than 5) [17].

The multivariate logistic regression model was used to obtain the prognostic factors for prolonged MV [18].

The significance level used for the tests was 5%.

RESULTS

The average age of the patients was 62.2 years, with 69.9% of patients were male, 15.3% were smokers, 82.8% and 36.6% hypertensive diabetics.

The clinical characteristics preoperative are described in Table 1. Patients on prolonged MV when compared to other, older and had a higher prevalence of chronic obstructive pulmonary disease (COPD), heart failure (HF), cerebrovascular disease and chronic renal failure (CRF), in addition to longer hospital pre surgery.

Table 2 shows the characteristics intraoperative. Patients on prolonged MV group had a smaller proportion of cases with CABG and higher clamping time compared to the group extubated in less than 48 hours (P <0.001).

Table 3 presents a univariate analysis of preoperative and intraoperative considered clinically relevant as predictors of prolonged MV. We considered as predictors of prolonged MV: age, HF, prior cerebrovascular disease, CRF, creatinine, COPD, clamping time, and CABG combined with other procedures including valve.

Based on Tables 1 and 2, we take the variables with P <0.25 to compose a set of candidate variables to identify possible predictors of MV> 48 hours. Using the logistic regression model with variable selection process "stepwise", observed that: the age, CRF, COPD, CABG and other procedures associated with clamping time are predictors of MV 48> hours. Table 4 presents these results.

Table 1. Descriptive results of preoperative demographic variables and their distribution in groups.

		VM Time		
Variable		≤ 48h	> 48h	*P* Value
Age, mean + SD (years)		62.0 + 9.5	67.3 + 9.1	< 0.001(1)
BMI, mean + SD (kg/m²)		27.0 + 4.1	26.0 + 4.3	0.036(1)
Creatinine, mean + SD (mg/dL)		1.3 + 0.7	1.6 + 1.4	0.050(1)
Systolic BP, mean + SD (mmHg)		132.4 + 20.1	136.5 + 20.6	0.104(1) (NS)
Diastolic BP, mean ± SD		80.4 + 11.7	81.6 + 12.4	0.434(1) (NS)
Internment pre-op., mean + SD (days)		2.7 + 3.3	3.4 + 3.5	0.033(2)
CRF, n (%)		146 (5.1)	16 (20.8)	< 0.001(4)
Hypertension, n (%)		2375 (82.6)	69 (89.6)	0.108(3) (NS)
COPD, n (%)		193 (6.7)	14 (18.2)	< 0.001(3)
DAC, n (%)		856 (29.8)	15 (19.5)	0.051(3) (NS)
Diabetes mellitus, n (%)		1048 (36.5)	30 (39)	0.652(3) (NS)
Dyslipidemia, n (%)		1292 (44.9)	31 (40.3)	0.415(3) (NS)
Arterial insufficiency, n (%)		136 (4.7)	7 (9.1)	0.097(4) (NS)
Cerebrovascular disease, n (%)		49 (1.7)	4 (5.2)	0.048(4)
HF, n (%)		73 (2.5)	7 (9.1)	0.004(4)
Angina, n (%)		2138 (74.4)	54 (70.1)	0.402(3) (NS)
Arrhythmia, n (%)		152 (5.3)	7 (9.1)	0.191(4) (NS)
Valve surgery, n (%)		7 (2.2)	1 (1.3)	0.183(4) (NS)
Angioplasty, n (%)		255 (8.9)	4 (5)	0.055(4) (NS)
Smoking, n (%)	Yes	1284 (44.7)	35 (45.5)	0.980(3) (NS)
	No	438 (15.2)	12 (15.6)	
	Prior	1153 (40.1)	30 (39)	

(1) descriptive level of probability of Student's t test, (2) descriptive level of probability of the nonparametric Mann-Whitney test, (3) descriptive level of probability of the chi-square (4) descriptive level of probability Fisher's exact test, BMI - body mass index, BP - blood pressure, CRF - chronic renal failure (creatinine> 2 mg / dL), COPD - chronic obstructive pulmonary disease, CAD - coronary artery disease HF - heart failure; MV - mechanical ventilation, NS - not significant, SD - standard deviation

Table 2. Descriptive results of the intraoperative variables and their distribution in groups.

		MV Time		
Variable		≤ 48h	> 48h	*P* Value
Type of surgery,	Elective	2849 (99.1)	75 (97.4)	0.165(4) (NS)
n (%)	Urgency	26 (0.9)	2 (2.6)	
Using ATI, n (%)		2530 (88.0)	65 (84.4)	0.341(3) (NS)
CABG, n (%)		2596 (90.3)	51 (66.2)	< 0.001(3)
Valve associated, n (%)		116 (4.0)	15 (19.5)	< 0.001(4)
Support CEC, n (%)		2527 (87.9)	70 (90.9)	0.422(3) (NS)
Clamping time, mean ± SD (min)		46.1+ 21.8	60.2 +39.0	< 0.001(1)
Temperature	Hypothermia (≤ 34°C)	1697 (67.1)	53 (75.7)	0.136(3) (NS)
n (%)	Normothermia (> 34°C)	830 (32.9)	17 (24.3)	

(1) descriptive level of probability of Student's t test, (2) descriptive level of probability of the nonparametric Mann-Whitney test, (3) descriptive level of probability of the chi-square (4) descriptive level of probability Fisher's exact test; ITA - internal thoracic artery CABG - coronary artery bypass grafting, CPB - cardiopulmonary bypass; MV-mechanical ventilation, NS - not significant, SD - standard deviation.

Table 3. Univariate analysis of clinically relevant variables for prolonged MV.

		95% CI		
Variable	OR	Lim Inf	Sup Lim	*P* Value
Age	1.07	1.04	1.09	< 0.001
BMI	0.94	0.88	1.00	0.035
Creatinine	1.29	1.11	1.50	< 0.001
Systolic BP	1.01	1.00	1.02	0.104 (NS)
Internment pre op.	1.04	1.00	1.09	0.074 (NS)
CABG	4.90	2.76	8.71	< 0.001
SH	1.82	0.87	3.80	0.113 (NS)
COPD	3.09	1.70	5.61	< 0.001
CAD	0.57	0.32	1.01	0.054 (NS)
Arterial insufficiency	2.02	0.91	4.46	0.085 (NS)
Cerebrovascular disease	3.16	1.11	8.99	0.031
HF	3.84	1.71	8.64	0.001
Arrhythmia	1.79	0.81	3.96	0.150 (NS)
Valve surgery prior	5.39	0.66	44.36	0.117 (NS)
Angioplasty	0.56	0.20	1.55	0.267 (NS)
Surgical indication urgency	2.92	0.68	12.54	0.149 (NS)
CABG	0.21	0.13	0.34	< 0.001
Valvular surgery associated	5.76	3.18	10.42	< 0.001
Time clamping	1.02	1.01	1.03	< 0.001

OR "Odds Ratio" - odds ratio, BMI - body mass index, BP - blood pressure, CRF - chronic renal failure (creatinine> 2 mg / dL), COPD - chronic obstructive pulmonary disease; DAC - coronary artery disease, HF - heart failure, CABG - coronary artery bypass grafting, NS - not significant, MV - mechanical ventilation, CI - confidence interval, Lim Inf - lower limit, Sup Lim - upper limit

Table 4. Multivariate analysis of variables associated with prolonged MV.

		95% CI		
Variable	OR	Lim Inf	Sup Lim	*P* Value
Age	1.06	1.03	1.09	< 0.001
CRF	3.52	1.84	6.74	< 0.001
COPD	2.65	1.38	5.09	0.004
CABG associated with other procedures	3.33	1.89	5.88	< 0.001
Clamping time	1.01	1.00	1.02	0.018

OR "Odds Ratio" - odds ratio, CRF - chronic renal failure (creatinine> 2 mg / dL); COPD - chronic obstructive pulmonary disease, CABG - coronary artery bypass grafting, CI - confidence interval, Lim Inf - lower limit; Sup Lim - upper limit

Table 5 presents the distribution of postoperative complications cases arranged as divided in the MV 48h. It is observed that patients in prolonged MV higher proportion of complications when compared to extubated at least 48 hours.

DISCUSSION

The implementation of CABG requires adequate organizational support [8]. The results depend on the clinical condition of the patient, surgeon expertise, intensive care and trained multidisciplinary team, as well as appropriate follow-up after surgery in order to be successful, with a short and uneventful [19].

As reported by Vincent A. Gaudiani: "The goal of a cardiac surgery program is to encourage patients to safer and less threatening journey through the hospital" [20]. They are essential to the success of this procedure, the type of heart disease, careful selection of cases, the precise preoperative diagnosis, adequate preoperative preparation, anesthesia team specialized intensive care postoperative appropriate, specific equipment in good operation, trained multidisciplinary team, fast and accurate laboratory, blood bank and able to meet demands faster [8].

The prolonged MV after CABG is still common in ICUs, despite the great advances made in recent years. In the present study, prolonged MV was defined according to scientific evidence, such as invasive ventilation for more than 48 hours

Table 5. Descriptive results of the complications and their distribution in groups.

	Time VM		
Complications	≤ 48h	> 48h	*P* Value
Reoperation, n (%)	59 (2.1)	18 (23.4)	< 0.001(2)
Perioperative MI, n (%)	28 (1)	5 (6.5)	< 0.001(2)
Neurological, n (%)	204 (7.1)	37 (48.1)	< 0.001(2)
AVE, n (%)	40 (1.4)	13 (16.9)	< 0.001(2)
Renal, n (%)	100 (3.5)	36 (46.8)	< 0.001(2)
Infectious, n (%)	235 (8.2)	42 (54.6)	< 0.001(1)
Lung, n (%)	372 (12.9)	73 (94.8)	< 0.001(1)
ARDS, n (%)	6 (0.2)	5 (6.5)	< 0.001(2)
Pulmonary embolism, n (%)	7 (0.2)	0	1.000(2)
Pneumonia, n (%)	141 (4.9)	44 (57.1)	< 0.001(2)
Other pulmonary, n (%)	12 (0.4)	3 (3.9)	0.006(2)
Vascular, n (%)	16 (0.6)	5 (6.5)	< 0.001(2)
Gastrointestinal, n (%)	128 (4.5)	41 (53.3)	< 0.001(2)
Cardiopulmonary, n (%)	58 (2.0)	30 (39)	< 0.001(2)
Arrhythmia, n (%)	498 (17.3)	46 (59.7)	< 0.001(1)
CI, n (%)	82 (2.9)	16 (20.8)	< 0.001(2)
Cardiogenic shock, n (%)	25 (0.9)	11 (14.3)	< 0.001(2)
Multiple organ failure, n (%)	4 (0.1)	9 (11.7)	< 0.001(2)
Other complications, n (%)	73 (2.5)	10 (13)	< 0.001(2)

(1) descriptive level of probability of the chi-square (2) descriptive level of probability of the Fisher exact test, AMI - acute myocardial infarction, stroke - stroke; ARDS - acute respiratory distress syndrome in adults, CI - heart failure; VM - Mechanical Ventilation

[21-23]. Several studies show that the incidence of these cases prolonged MV varies from 3.0 to 9.9% [24]. Of the 2952 patients included in this study, only 77 (2.6%) remained on MV for more than 48 hours, the lowest rate in the literature.

The prolonged MV has great clinical relevance because it is correlated with increased morbidity and mortality, in addition to large economic impact, due to the increased length of stay and resultant increase in costs. The hospitalization of patients with prolonged MV exceed 2 to 3 weeks and his hospital mortality may exceed 40% for those extubated earlier [13]. In a study conducted in Germany, the effective cost of patients on MV for more than 4 days was 18 times higher than those taken from the MV earlier [25].

Therefore, the identification of predictors of prolonged MV is extremely important because it allows the optimization of those patients at higher risk even before the start of surgery and assists physicians in managing postoperative clinical, to minimize this complication [26].

With regard to preoperative characteristics, patients with prolonged MV were older. This group also had a longer preoperative hospitalization, due to his medical condition worse. These patients had higher prevalence of COPD, heart failure, renal failure and cerebrovascular disease, as observed in other studies (Table 1) [13,21,24,27-32].

Univariate analysis demonstrated as predictors of prolonged MV age, HF, prior cerebrovascular disease, CRF, creatinine> 2 mg / dL, COPD, clamping and CABG combined with other procedures including valve. Other studies have also shown these factors as predictors of prolonged MV (Table 3) [13, 24,27,29,30-32].

Patients with a higher BMI were less likely to prolonged MV (OR 0.94 95% CI 0.88 to 1.00, $P = 0.035$), which is contrary to data from other studies. Jin et al. [33] observed that the chance of prolonged MV increases significantly with increasing BMI, and Wigfiel et al. [34] reported that obesity is a risk factor for prolonged MV [21]. Mean BMI of the patients studied when divided in groups according to the time of MV were 26 ± 4.3 kg/m^2 for the group with prolonged MV, and 27 ± 4.1 kg/m^2 for the group with MV ≤ 48h (P = 0.036). This difference, although statistically significant, is not clinically relevant, considering the great similarity of the mean BMI of the two groups.

After adjusting for confounding factors, multivariate analysis was performed which identified the following factors as independent predictors of prolonged MV: age, CRF, COPD, CABG and other procedures associated with clamping time (Table 4).

Aging is one of the most important factors of poor prognosis in CABG, generally associated with increased morbidity and mortality. As demonstrated in this study, age is a predictor of prolonged MV, with an odds ratio of 1.06. This result is in agreement with the majority of published studies in this area [21,27-30].

CRF was defined as serum creatinine> 2.0 mg / dL, regardless of patients are not dependent or dialysis. Its incidence was 20.8% in patients with prolonged MV, and only 5.1% of those taken from MV in less than 48 hours. It was the strongest predictor in this study (OR 3.52 95% CI 1.84 to 6.74, P <0.001). Other studies have also shown similar results [26,27,29,32].

COPD is cited in the literature as a strong predictor of prolonged MV [22,26,27,31] as well as in our study (OR 2.65 95% CI 1.38 to 5.09, P = 0.004). Studies show that patients with COPD have proportionally higher mortality rate [27]. These patients prothrombotic condition, due to increased blood viscosity and endothelial dysfunction. Moreover, often share comorbidities like atherosclerosis, smoking and systemic vascular disease, and are more prone to complications in the postoperative period [35-37]. However, some studies do not point to COPD as a predictor of prolonged MV [24,28-30,32].

The procedure associated with other CABG was also a predictor of prolonged MV. As for the associated surgical procedures CABG, the group showed prolonged MV rate of 33.8%, since the other group, 9.7% (P <0.001). Among these associated procedures, valvular surgeries were the most frequent, accounting for 42.9% of them. Branca et al. [29] also found that CABG associated with other procedures increases the risk of prolonged MV. And Rajakaruna et al. [38] observed an increase of 8.5 times the risk of prolonged MV in patients undergoing aortic surgery associated with CABG.

Patients with prolonged MV group showed significantly greater clamping time, averaging 60.2 ± 39.0 min, compared to the other group, with 46.1 ± 21.8 min (P <0.001). This was also a predictor of prolonged MV (OR 1.01 95% CI 1.00 to 1.02, P = 0.018). Several other studies confirm this association [22,24,29-32].

As demonstrated in the literature, patients who remain in prolonged MV have higher morbidity and mortality [22,24,26-32]. In this study, these patients had significantly higher reoperation rate and a higher incidence of complications. Among these, figure as the most relevant, pulmonary complications, arrhythmias, infectious, gastrointestinal, neurological and kidney. The length of stay of these patients in the ICU was on average 14.1 ± 13.1 days, while patients who were removed from the MV in less than 48 hours were, on average, only 2.1 + 3.5 days (P <0.001). Also, mortality in these patients was significantly higher, with a rate of 58.44%, while the mortality of those with lower MV 48h was only 2.26% (P <0.001), representing a likelihood of death 25.5 times higher in patients with prolonged MV. Other studies also show high rates of mortality in patients with MV for over 48 hours, with values of 18.5% [27], 22.3% [29] and 36.3% [32].

Several previous publications have evaluated the predictors of prolonged MV. However, most of these studies are retrospective and include a period of extensive data collection (average 4-5 years) in order to obtain a representative sample. These characteristics can lead to accumulation of biases arising from changes in the profile of patients during the collection period, and variations of operation of the service itself. This study, in turn, had a significant sample of 3010 patients, in only one year of data collection, which minimizes these effects. As far as we know, there is no published study with those dimensions that evaluated predictors of prolonged MV in patients undergoing CABG in a period as short review (PubMed and LILACS).

The retrospective nature of this study may give limitations inherent to its design. In addition to possible selection bias, interpretation of results is not possible to determine the causality of the associations between variables. Although the percentage of loss of patient inclusion in the database occurred randomly, it also gives a limitation of the study; it may have contributed to a selection bias in the sample.

CONCLUSION

Are independent predictors of prolonged MV: age, COPD, CRF, CABG and clamping time associated with other procedures? Identifying these factors enables the development of preventive strategies that reduce the time of invasive ventilation, since patients in prolonged MV have higher morbidity and mortality.

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