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RESEARCH ARTICLE

IMPACT OF AGE, GENDER, AND CO MORBIDITIES IN CARDIOPULMONARY INDICATORS AND DYSFUNCTIONAL VENTILATOR WEANING RESPONSE AFTER CORONARY ARTERY BYPASS GRAFT SURGERY

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ABSTRACT

About 20% to 40% of patients who have undergone Coronary Artery Bypass Graft Surgery (CBAG) remain intubated 12 hours after surgery due to dysfunctional ventilator weaning response (DVWR). DVWR is associated with increased morbidity and mortality (30% to 43%) following CABG surgery. Literature review revealed that there is an association between gender and preoperative co- morbidities and post-operative hemodynamic alterations. Finding significant antecedence to predict DVWR could help to identify and prevent the complications from DVWR after CABG surgery. The purposes of this secondary analysis were to describe the gender and co morbidity distribution among patients those who developed dysfunctional ventilator weaning response and normal ventilator weaning response(NVWR) after CABG surgery and to determine the differences in the distribution of gender and co morbidity among patients with DVWR and NVWR. Findings of the secondary analysis revealed that gender had significant effects on hemodynamic cardiopulmonary indicators (CPI) such as MAP ($p = 0.0012$), CO ($p < 0.0001$), and CI ($p < 0.0001$) post operatively. From these findings, future studies may be conducted using prospective designs in finding the associations and predictive values of gender, co morbidities and cardiopulmonary indicators in Dysfunctional ventilator weaning response, which may have implications in quality care of patients who undergo CABG surgery.

INTRODUCTION

Dysfunctional ventilator weaning response (DVWR) is a major problem among postoperative Coronary Artery Bypass Graft (CABG) patients because it is associated with increased morbidity and mortality following CABG surgery (Brucek, Straka, Vanek, and Jares, 2003; Currey and Botti, 2003; Ferguson *et al*., 2001; Nakai, Bando, Nishimura, and Kataoka, 1995; Nickerson, Murphy, Davila-Roman, Schechtman, and Kouchoukos, 1999; Westaby *et al*., 1993). The mortality related to DVWR is reported as 30% to 43% (Yende and Wunderink, 2002a, 2002b). It results from many complications of DVWR such as acute respiratory distress syndrome, 10% to 15% (Yende and Wunderink, 2002a, 2002b); multiorgan dysfunction syndrome, 15% to 19% (Yende and Wunderink, 2002a, 2002b); deep vein thrombosis, 10% to 12% (Kollef, Wragge, and Pasque, 1995; Kollef, Horst, Prang, and Brock, 1998; Kollef and Silver, 1995); and ventilator-associated pneumonia, 30% to 50% (Vijay and Gold, 2003; Vijay and McCusker, 2003). Other health care problems resulting from DVWR are increased Intensive care length of stay and cost (Bardell, Legare, Buth, Hirsch, and Ali, 2003; Doering, Esmailian, and Laks, 2000; Nickerson *et al*., 1999; Suematsu *et al*., 2000). Early detection of DVWR is imperative to prevent postoperative complications and premature weaning after CABG surgery.

Gender differences in postoperative recovery among patients who have undergone coronary artery bypass graft surgery are not well established. Some researchers have reported that women have more complications after coronary artery bypass surgery than men. Many researchers have reported that some co morbidity variables are associated with DVWR such as chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), emergency surgery, and number of grafts are found to be associated with DVWR and PMV (Alexander and Cooper, 1996; Bezanson *et al*., 2001; Bezanson, Weaver, Kinney, Waldrum, and Weintraub, 2004; Calzia, Koch, Stahl, Radermacher, and Brinkmann, 2001; Yende and Wunderink, 2002a, 2002b). Some researchers reported that DVWR is associated with the adult respiratory distress syndrome after CABG surgery (Alexander and Cooper, 1996; Anderson *et al*., 1999; Chong, Li, Wang, and Chang, 2003; Dias *et al*., 1992; M. H. Kollef, Wragge, and Pasque, 1995; Plumer, Markewitz, Marohl, Bernutz, and Weinhold, 1998; Thelan, 1998).

Clinically, hemodynamic stabilization is monitored through Cardio Pulmonary Indicators (CPI). Cardiopulmonary indicators are sensitive indicators in identifying complications among cardiac surgery patients. Some researchers have reported that the trends of hemodynamic variables for 4 hours following Intensive Care Unit (ICU) admission after CABG surgery are sensitive indicators of prognosis. In addition, CPI is reliable in detecting complications after heart surgery irrespective of comorbid factors associated with outcomes. Furthermore, some researchers have reported that cardiopulmonary indicators are helpful in rapid diagnosis of postoperative complications among heart surgery patients. Other research findings reveal that changes in CPI are reliable indicators of postoperative adverse events. The selected CPI to predict DVWR in this research study include heart rate (HR), mean arterial blood pressure (MAP), central venous pressure (CVP), cardiac output (CO), respiratory rate (RR), mixed venous oxygen (SVO_2), oxygen saturation, pulmonary artery diastolic pressure (PAD), and pulmonary artery systolic pressure (PASP). Finding reliable predictive factors could help in the early detection of DVWR and might guide in planning early treatment for DVWR, and may aid in

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preventing complications and premature weaning after CABG surgery. This secondary data analysis was performed with the purpose of describing, finding the differences and impact in the distribution of age, gender, and co morbidities in CPI and Dysfunctional Ventilator Weaning Response after CABG surgery.

Purpose

The purposes of this secondary analysis were to:

- Describe the gender and co morbidity distribution among patients those who developed DVWR and NVWR after CABG surgery.
- Determine the differences in the distribution of gender and co morbidity among patients with DVWR and NVWR.
- Identify the impact of gender and co morbidity in cardiopulmonary indicators after Coronary Artery Bypass Graft surgery.

METERIALS AND METHODS

This secondary data analysis utilized a previous data set collected for a retrospective case control analysis with time series design. After the Institution Review board approval, the primary data set was acquired using inclusion criteria guided purposive sampling technique to recruit 300 subjects from a retrospective audit of electronic medical records of patients who underwent CABG surgery between May 2003 and February 2006. Among the 300 subjects, 100 subjects constituted the case group (DVWR) and 200 constituted the control group (NVWR). Data analysis consisted of descriptive and inferential statistics and the statistical analysis was performed using SAS programs, including PROC Univariate, PROC FREQ, and PROC GLM. The impact of age, gender, and co morbidity variables on CPI was tested through an ANOVA for a repeated- measures model-based design using the PROC MIXED procedure of SAS including the above variables as covariates in the analysis. The covariates in this analysis included age, gender, BSA, number of grafts, COPD, CHF, and renal failure.

RESULTS AND DISCUSSION

Sample description

The analysis sample consisted of subjects who ranged in age from 33 years to 91years. The mean age of the subjects in the case group was 64.28 ± 11.45 years. The mean age of the subjects in the control group was 61.8 ± 11.05 years. The majority of the analysis sample consisted of 204 male subjects (68.23%); the number of female patients was 95 (31.77%). The case group consisted of 58 (58.59%) males, and the control group consisted of 146 (73%) males. Co morbid conditions that were included in this analysis were COPD, CHF, and renal disease. The total number of subjects who had co morbid conditions was 55 (18.39%). The subjects who had COPD constituted the majority at 31 (10.37%); the number of CHF Subjects was 16 (5.35%), and the number of renal failures was 8 (2.68%).

Impact of Body surface area and dysfunctional ventilator weaning response

In this analysis, there was no significant difference in mean BSA between cases and controls. Repeated measure ANOVA analysis revealed that BSA had significant effect on CPI such as CVP ($p = 0.04$), RR ($p = 0.0028$), SPO_2 ($p = 0.0034$), CO ($p < 0.0001$), CI ($p < 0.0001$), and PASP ($p = 0.0059$). This finding is consistent with the literature reported that obesity is not associated with extubation failure after CABG surgery. However, including the body mass index in future prospective studies may be beneficial.

Impact of Age in CPI and dysfunctional ventilator weaning response

To find the differences in the age groups between cases and controls, a Chi-square test was performed. The analysis revealed that there was no significant difference in age groups between cases and controls. However, age had a significant effect on CPI, such as HR ($p = 0.008$), MAP ($p = 0.0028$), SPO_2 ($p = 0.042$), CO ($p = 0.015$), CI ($p = 0.016$), and PAD ($p = 0.04$). These findings were consistent with the findings of Legare, *et al*. (2001) (Legare, Hirsch, Buth, MacDougall, and Sullivan, 2001). Although age had a significant effect on the above CPI, a logistic regression analysis revealed that age did not have significant predictive value for DVWR after CABG surgery. This finding implies that age had no significant effect on DVWR after CABG surgery. This finding was consistent with Bezanson, *et al*. (2001) who reported that age has no effect on PMV after CABG surgery (Bezanson *et al*., 2001). The finding also agrees with current literature which indicates that increased age is not associated with PMV after CABG surgery (Bezanson *et al*., 2001; Bezanson *et al*., 2004; Branca, McGaw, and Light, 2001; Brucek *et al*., 2003).

Impact of Gender in CPI and dysfunctional ventilator weaning response

To find the differences in the distribution of gender between cases and controls, a Chi-square test was performed. The analysis revealed that there was a significant ($p = 0.01$) difference in the distribution of gender between cases and controls. This finding is consistent with studies those reported that gender was not found to be an independent predictor for prolonged ventilation after CABG surgery. In addition, this analysis finding revealed that gender had significant effects on CPI such as MAP ($p = 0.0012$), CO ($p < 0.0001$), and CI ($p < 0.0001$). Although, gender had a significant effect on these CPI, a logistic regression model revealed that gender had no significant predictive value for DVWR after CABG surgery. This finding contrasts with the findings of Legare, *et al*. (2001) who reported that females are at risk of developing DVWR after CABG surgery (Legare *et al*., 2001). This contrast finding may be explained by the sample size. Legare, *et al*.,used a large sample size of 1,800 subjects when compared with this analysis, which had smaller sample size involving 300 subjects. The significance of female gender may be visible more in the larger sample size. Legare, *et al*. included all the subjects without exclusion criteria; this may be another factor that could contribute to the contrast finding. Although these analysis findings revealed that females are not at risk of developing DVWR, it is imperative to add gender as an independent variable in future studies in consideration with physiological differences between the genders.

Number of grafts dysfunctional ventilator weaning response

The number of grafts ranged from 1 to 6. The number of subjects who had one graft in cases was 6 (6.06%), and in controls 7 (3.52%). The number of subjects who had two grafts in cases was 13 (13.13%), and in controls 38 (38.38%). The number of subjects who had three grafts in cases was 38 (38.38%), and in controls 75 (37.69%). The number of subjects who had four grafts in cases was 30 (30.30%) and in controls 53 (26.63%). The number of subjects who had five grafts in cases was 10 (10.10%), and in controls 20 (10.05%). The number of subjects who had 6 grafts in cases was 2 (2.02%) and in controls 6 (3.02%). To describe the differences between cases and controls in the number of grafts, a Chi-square test was preformed, which revealed that there was no significant difference in the number of grafts between cases and controls.

Co Morbidities and dysfunctional ventilator weaning response

To find the differences in the prevalence of the comorbidities between cases and controls, a Chi-square test was performed. The analysis revealed that there was no significant difference in the prevalence of renal failure between cases and controls. However, the prevalence of COPD showed a significant ($p < 0.0001$) difference between cases and controls. In addition, the prevalence of CHF

showed a significant (p = 0.0003) difference between cases and controls.

Impact of co morbidities in CPI and dysfunctional ventilator weaning response:

Impact of Renal failure in CPI and dysfunctional ventilator weaning response:

This analysis found that renal failure is not a significant predictor for DVWR after CABG surgery. There was no significant difference in the prevalence of renal failure between cases and controls in this analysis sample. A repeated measure ANOVA analysis revealed that renal failure had a significant (p = 0.019) effect on SPO_2. This finding is consistent with the literature, which indicates that renal anemia predisposes to alterations in SPO_2 because it induces functional and organic alterations of cardiac-circulatory function.

Impact of Chronic obstructive pulmonary disease in CPI and dysfunctional ventilator weaning response

In this analysis, the prevalence of COPD was found to make a significant (p < 0.0001) difference between cases and controls. This finding was consistent with Legare, *et al.* (2001) who indicated that COPD is a significant preoperative risk factor for PMV after CABG surgery (Legare *et al*., 2001). In addition, this analysis's finding revealed that COPD had no significant effect on any of the selected CPI, which implies that COPD is an independent risk factor for DVWR. This finding is consistent with the literature that indicates that COPD is associated with DVWR (Brum *et al*., 2003; Chailleux, Fauroux, Binet, Dautzenberg, and Polu, 1996; Chao, Scheinhorn, and Stearn-Hassenpflug, 1997; Currey and Botti, 2003; Savino *et al*., 2002). Further, a regression model of this analysis affirmed that COPD is a significant (p = 0.0003) predictor for DVWR after CABG surgery.

Impact of Congestive heart failure in CPI and dysfunctional ventilator weaning response

In this analysis, the prevalence of CHF resulted in a significant (p = 0.0003) difference between cases and controls. This finding was consistent with the literature that indicated an association of congestive heart failure (CHF) with PMV after CABG surgery (Alexander and Cooper, 1996; Bezanson *et al*., 2001; Bezanson *et al*., 2004; Calzia *et al*., 2001; Yende and Wunderink, 2002a, 2002b). In this analysis, CHF had significant effect on CPI (p = 0.0034). This finding is consistent with the literature that indicates the effect of CHF on PASP is due to the cardiopulmonary dynamics, explained by Boldt and Hempelmann (2001) as follows: The pathophysiological changes due to left ventricular failure are associated with the increased pulmonary pressures and decreased cardiac output resulting in delayed ventilator weaning. In addition, cardiac surgery depresses the myocardial pump function. Other literature explained that right heart failure is associated with an increased right atrial pressure, and impeding venous return and venous congestion alter hemodynamics and pulmonary artery pressures.

Conclusion

The results from this secondary analysis may be inferred as that patients with a history of COPD and CHF have significant risk of developing DVWR after CABG surgery. In addition, age, gender, and body surface area are also found to show significant differences between cases and control. Therefore, this researcher recommends that weaning criteria be developed considering the above risk factors for high risk patients after CABG surgery.

Implications and limitations

This analysis's results have implications for the theory, practice, education, and research involving postoperative care after CABG surgery from the perspectives of early detection, prevention, and treatment of DVWR. The specific knowledge derived from this analysis can be used to benefit the fields of critical care medicine, critical care nursing, and critical care administration in the aspects of theory, practice, education, research, quality improvement, and cost-effective care in postoperative critical care after CABG surgery. However, these findings have to be verified by replicated prospective studies before generalization for the practice due to the limitation of secondary analysis included retrospective data with purposive sampling method.

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