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Preoperative Treatment of Obstructive Sleep Apnea With Positive Airway Pressure is Associated With Decreased Incidence of Atrial Fibrillation After Cardiac Surgery

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Objective: Based on clinical studies in the nonsurgical population that positive airway pressure (PAP) therapy for patients with obstructive sleep apnea (OSA) provides benefits for those with atrial fibrillation, the authors tested the hypothesis that PAP in patients with OSA reduces the incidence of postoperative atrial fibrillation (POAF) after cardiac surgery.
Design: Retrospective analysis.
Setting: Single-center university hospital.
Participants: The study comprised 192 patients in sinus rhythm preoperatively who were undergoing nontransplantation or ventricular assist device implantation cardiac surgery requiring cardiopulmonary bypass but not requiring systemic circulatory arrest, with documented PAP adherence from January 2008 to October 2015.
Interventions: Retrospective review of medical records.
Measurements and Main Results: POAF was defined as atrial fibrillation requiring therapeutic intervention. Of the 192 patients with OSA, 104 (54%) were documented to be PAP-adherent and 88 (46%) were reported to be PAP-nonadherent. Among PAP users, 49 (47%) developed POAF; among PAP nonusers, 59 (66%) developed POAF. The adjusted hazard ratio was 0.59 (95% confidence interval 0.40-0.86, $p < 0.01$). No differences were observed in intensive care unit length of stay (4.0 ± 3.4 days for PAP-adherent group *v* 5.0 ± 6.2 days for PAP-nonadherent group; $p = 0.22$) or hospital length of stay (10.7 ± 6.6 days for PAP-adherent group *v* 10.9 ± 7.3 days for PAP nonadherent group; $p = 0.56$). A lower median postoperative creatinine rise was observed in PAP-adherent patients (18.2% [8.3%-37.5%) *v* 31.3% [13.3%-50%]; $p < 0.01$).
Conclusion: Preoperative PAP use in patients with OSA was associated with a decreased rate of POAF after cardiac surgery.
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Key Words: obstructive sleep apnea; positive airway pressure; postoperative atrial fibrillation; cardiac surgery

POSTOPERATIVE ATRIAL FIBRILLATION (POAF) in cardiac surgery patients is a common complication that is associated with increased length of intensive care unit (ICU) and hospital lengths of stay, readmission rates, and total hospital costs.[1] Prediction models have identified many risk

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factors for POAF, including age, history of atrial fibrillation, and valve surgery.[2] Published studies also have identified obstructive sleep apnea (OSA) as a risk factor for POAF after cardiac surgery[3,4] and atrial fibrillation in nonsurgical patients.[5,6]

The role of OSA in the pathogenesis of atrial fibrillation likely involves multiple mechanisms. Repetitive respiratory efforts against an occluded airway generate significant negative intrathoracic pressures; subsequent restoration of airflow upon arousal results in rapid changes in cardiac loading conditions,[7,8] which may lead to atrial remodeling and a predisposition to atrial fibrillation.[9] Intrathoracic pressure changes associated with OSA also may induce changes in atrial electrophysiologic characteristics identified as risk factors for atrial fibrillation.[10-12] Repetitive hypoxemia and hypercapnia stimulate sympathetic nervous activity, and multiple animal studies have demonstrated an association between autonomic nervous system dysfunction and atrial fibrillation induced by OSA.[13,14]

Treatment of OSA with positive airway pressure (PAP) therapy decreased the rate of atrial fibrillation recurrence after ablation therapy[15-18] and reduced the odds of progression to permanent forms of atrial fibrillation in patients with OSA.[19] The effect of PAP therapy for OSA on the incidence of POAF in the cardiac surgical population, if any, has not been studied. Prevalence estimates of at least mild OSA are as high as 87% for patients undergoing coronary artery bypass grafting[20] and 77% for those referred for transcatheter aortic valve replacement.[21] Given the high prevalence of OSA in cardiac surgical patients and the association between OSA and POAF, treatment of OSA may offer an impactful target for reducing the rate of POAF. The authors tested the hypothesis that preoperative PAP therapy in patients with OSA undergoing cardiac surgery reduces the risk of POAF.

Methods and Materials

This retrospective cohort study was approved by the authors' Institutional Review Board with a waiver of informed consent.

Study Population and Setting

The electronic health records from patients who underwent cardiac surgery requiring cardiopulmonary bypass performed at a single tertiary care academic institution from January 2008 to October 2015 with a preoperative diagnosis of OSA and explicit written documentation of whether or not the patient was PAP-adherent preoperatively were evaluated. Patients were classified as PAP-adherent if they reported using PAP every night. Patients were classified as PAP-nonadherent if they reported not using an issued PAP device or occasionally using the PAP device or those who reported testing positive for OSA in the past but did not recall being issued a PAP device. Exclusion criteria were as follows: (1) preoperative cardiac rhythm other than sinus, (2) undocumented PAP adherence, (3) surgery requiring systemic circulatory arrest, or (4) transplantation and/or placement of a ventricular assist device.

Primary Outcome

POAF was defined as atrial fibrillation documented in the postoperative period requiring either pharmacologic treatment or direct-current cardioversion. The timing of the incident of POAF was determined by reviewing physician and nursing notes, pharmacy records, procedural notes (in cases of direct-current cardioversion), and electrocardiogram and telemetry strips. Records of only the immediate postoperative hospital stay were reviewed.

Secondary Outcomes

The following outcomes between PAP-adherent and PAP-nonadherent patients and between those who developed POAF and those who did not were compared: in-hospital death, pulmonary embolus or deep vein thrombosis documented using imaging or at autopsy, need for incident postoperative renal replacement therapy, reintubation rates, ICU readmission, cerebral vascular event or transient ischemic attack documented with imaging in conjunction with consultation of neurology services, days until tracheal extubation, and length of stay.

Given the recent finding by Kua et al[22] that coronary artery bypass grafting patients with OSA experienced a larger rise in postoperative creatinine than those without OSA, the authors explored differences in postoperative creatinine rise between PAP-adherent and PAP-nonadherent patients. Patients who required renal replacement therapy were excluded from this analysis. The peak percent rise in creatinine was calculated by subtracting the preoperative creatinine from the peak creatinine in the first 7 postoperative days and dividing by the preoperative creatinine.

Statistical Analysis

For the primary outcome, Kaplan-Meier methods were used to explore the unadjusted difference in POAF rates between the PAP-adherent and PAP-nonadherent groups. Cox proportional hazard analysis was used to adjust for covariates that differed between the groups in bivariate analyses ($p \leq 0.10$) or that previously have been identified as potential confounders.

The categorical secondary outcomes' relationship with PAP adherence were explored using univariable logistic regression. Length of stay data are presented as the median (interquartile range), and differences were analyzed using the Wilcoxon rank-sum test.

All tests were 2-tailed. A p value ≤ 0.05 was considered to be statistically significant. All statistical analyses were performed with SAS 9.4 (SAS Institute, Cary, NC).

Results

A total of 292 medical records were reviewed. Twenty-one patients' preoperative electrocardiogram did not show sinus rhythm. Forty-six surgeries did not require extracorporeal circulatory support (15 thoracic endovascular aortic repairs,