LUMEN ET VIRTUS

Impact of untreated sleep apnea on mortality: An analysis of patients without CPAP therapy

https://doi.org/10.56238/levv15n39-159

Cris Teixeira Rodrigues[1], José Guilherme Campos Martins[2], Lara Liotto de Carvalho[3], Pedro Henrique Santana Mazzarin[4], Lisa Aparecida da Silva Scarpari[5], Adenildo Felipe Santos Cardoso da Silva[6], Caroline Romero Cruz[7], Felipe Cardoso Amâncio[8], Alik Antunes Beserra[9], Rodrigo Daniel Zanoni[10].

ABSTRACT

Introduction: Obstructive sleep apnea (OSA) is a prevalent condition associated with a significant increase in overall and cardiovascular mortality, especially in untreated patients with continuous positive airway pressure (CPAP). This study systematically reviewed the literature to assess the impacts of untreated OSA on mortality and the benefits of CPAP treatment. Methods: A systematic review and meta-analysis was conducted. Observational studies, randomized controlled trials, and

[1] Medical Student, Unoeste, Universidade do Oeste Paulista, Guarujá, SP
E-mail: crisrodriguez107@gmail.com
ORCID: 0009-0002-7092-0809
[2] Medical Student, UNIFAI - Campus II - FAI - University Center of Adamantina
E-mail: Zehguilherme13@gmail.com
ORCID: 0009-0004-6533-130X
[3] Medical Student, University of Marília (UNIMAR), Marília-SP
E-mail: laraliotto@me.com
ORCID: 0009-0008-6568-7938
[4] Medical Student at FUNDEC - Unifadra Dracena, Dracena - SP
E-mail: pedromazarin@hotmail.com
ORCID: 0009-0001-5664-2913
[5] Medical Student, Universidade Nove de Julho - Vergueiro Campus, São Paulo - SP
E-mail: lisascarpari@hotmail.com
ORCID: 0009-0000-7393-2309
[6] Medical Student at UNIDERP - Campo Grande MS
Email: adenildofelipecardoso@gmail.com
ORCID: 0000-0002-5456-6726
[7] Doctor from Faculdade Ceres (FACERES), São José do Rio Preto
E-mail: carolineromero_2@outlook.com
ORCID: 0009-0008-5868-8350
[8] Doctor from Faculdade Ceres - São José do Rio Preto
E-mail: ftfelipe@hotmail.com
ORCID: 0009-0004-7325-7074
[9] Doctor from the University of Cuiabá
Otorhinolaryngology Resident at CASSEMS Hospital, Vivendas do Parque, Campo Grande – MS
E-mail: alik.antunes@gmail.com
ORCID: 0009-0003-2986-9471
[10] Physician from the Pontifical Catholic University of Campinas – SP
Master's Degree in Collective Health from Faculdade São Leopoldo Mandic Campinas
Technical Director of the Irineu Mazutti Longevity Center (CNES 9433856)
Technical Director of the Access Regulation Center - Sumaré (CNES 9216618)
Postgraduate in Dermatology and Dermatological Surgery from the BWS Institute
E-mail: drzanoni@gmail.com
ORCID: 0000-0001-7641-2851

prospective and retrospective cohorts investigating mortality in OSA patients not treated with CPAP were included. The PubMed, Scopus, and Web of Science databases were searched using specific terms related to OSA, CPAP, mortality, and cardiovascular complications. Results: We included 16 studies covering more than 10,000 patients. The meta-analysis revealed a pooled hazard ratio (HR) for overall mortality of 1.78 (95% CI: 1.50-2.10) and for cardiovascular mortality of 2.34 (95% CI: 1.90-2.88) in OSA patients not treated with CPAP. Significant reductions in cardiovascular and overall mortality are noted with the use of CPAP. Additional benefits included improvements in blood pressure, cognitive function, mental health, and sleep quality. Conclusion: The findings highlight the crucial importance of CPAP treatment to reduce overall and cardiovascular mortality in patients with OSA. Adherence to treatment should be encouraged through strategies of continuous support and patient education. Complementary interventions, such as weight loss and management of comorbidities, are essential to optimize health outcomes. CPAP therapy should be integrated as a central component in the management of obstructive sleep apnea.

Keywords: Obstructive Sleep Apnea, Mortality, CPAP.

INTRODUCTION

Obstructive sleep apnea (OSA) is a common condition, characterized by repeated episodes of partial or complete obstruction of the upper airway during sleep, leading to intermittent hypoxemia and sleep fragmentation. This condition is associated with a number of cardiovascular and metabolic comorbidities, significantly increasing the risk of mortality and morbidity in affected patients (Grimm & Becker, 2006; Marin et al., 2010).

The gold standard treatment for OSA is continuous positive airway pressure (CPAP) therapy, which keeps the airway open during sleep, preventing apnea episodes and their adverse effects. However, adherence to CPAP treatment is a significant challenge, with many patients not using the device as prescribed (Wang et al., 2007; Ou et al., 2015).

Studies have shown that lack of CPAP treatment in OSA patients results in a notable increase in mortality rates, especially due to cardiovascular complications. Patients with congestive heart failure who do not treat OSA have a significantly higher risk of mortality compared to those who receive adequate CPAP treatment (Martinez-García et al., 2009; Schwab et al., 2020).

This study aims to analyze the impact of untreated sleep apnea on patient mortality, with a specific focus on those who do not use CPAP therapy. Using a systematic review of clinical and observational studies, we aim to clarify the consequences of lack of treatment and highlight the importance of adherence to CPAP therapy for improving health outcomes and reducing mortality in patients with OSA.

MATERIALS AND METHODS

This study was conducted as a systematic review to investigate the impact of untreated obstructive sleep apnea (OSA) on patient mortality, with an emphasis on those who do not use continuous positive airway pressure (CPAP) therapy

INCLUSION CRITERIA

- Studies that investigated mortality in OSA patients without CPAP treatment.
- Studies published in English, Portuguese or Spanish.
- Observational studies, randomized controlled trials, and prospective and retrospective cohorts.
- Full articles available in accessible databases (PubMed, Scopus, Web of Science).

EXCLUSION CRITERIA

- Studies that do not clearly differentiate between patients treated and not treated with CPAP.
- Narrative reviews, opinion pieces, letters to the editor, and isolated case studies.

- Articles without quantitative data on mortality.

SEARCH STRATEGY

The search was performed in the electronic databases PubMed, Scopus and Web of Science, using the following search terms: "obstructive sleep apnea", "mortality", "untreated", "CPAP", "continuous positive airway pressure", "cardiovascular mortality", and "all-cause mortality". Equivalent terms in Portuguese and Spanish were also used.

SELECTION OF STUDIES

Initial screening of titles and abstracts was performed to identify potentially eligible studies. Studies that met the inclusion criteria were selected for a complete review of the text. Discrepancies in selection were resolved by consensus or by a third reviewer.

DATA EXTRACTION

Data were extracted in a standardized manner using an extraction form developed specifically for this study. The information extracted included:

- Author(s) and year of publication
- Study design
- Study population (number of participants, demographic characteristics)
- Diagnostic methods for OSA
- Interventions (CPAP use or not)
- Outcome measures (overall mortality and cardiovascular mortality)
- Key results

EVALUATION OF THE QUALITY OF STUDIES

The methodological quality of the included studies was assessed using the Newcastle-Ottawa Scale (NOS) for cohort studies and the Cochrane Risk of Bias Tool for randomised controlled trials. Studies were classified as high, moderate, or low quality based on the criteria of these tools.

DATA ANALYSIS

The data were synthesized qualitatively and, when possible, quantitatively. Heterogeneity between studies was assessed using Cochran's Q test and the I^2 statistic. For studies that showed low heterogeneity ($I^2 < 50\%$), a meta-analysis was performed using a fixed-effects model; otherwise, a random-effects model was used.

SUMMARY OF RESULTS

The results were presented in tables and graphs, highlighting mortality rates in OSA patients not treated with CPAP compared to those treated. The synthesis included subgroup analysis based on different demographic characteristics and associated comorbidities.

RESULTS

A total of 16 studies were identified that met the inclusion criteria and were included in the final analysis. Studies varied in design, including prospective and retrospective cohort studies, randomized controlled trials, and meta-analyses. The total population studied encompassed more than 10,000 OSA patients, with an age range that ranged from young adults to the elderly. The studies were conducted in several geographic regions, including North America, Europe, and Asia, which provides a global perspective on the impact of untreated OSA on mortality.

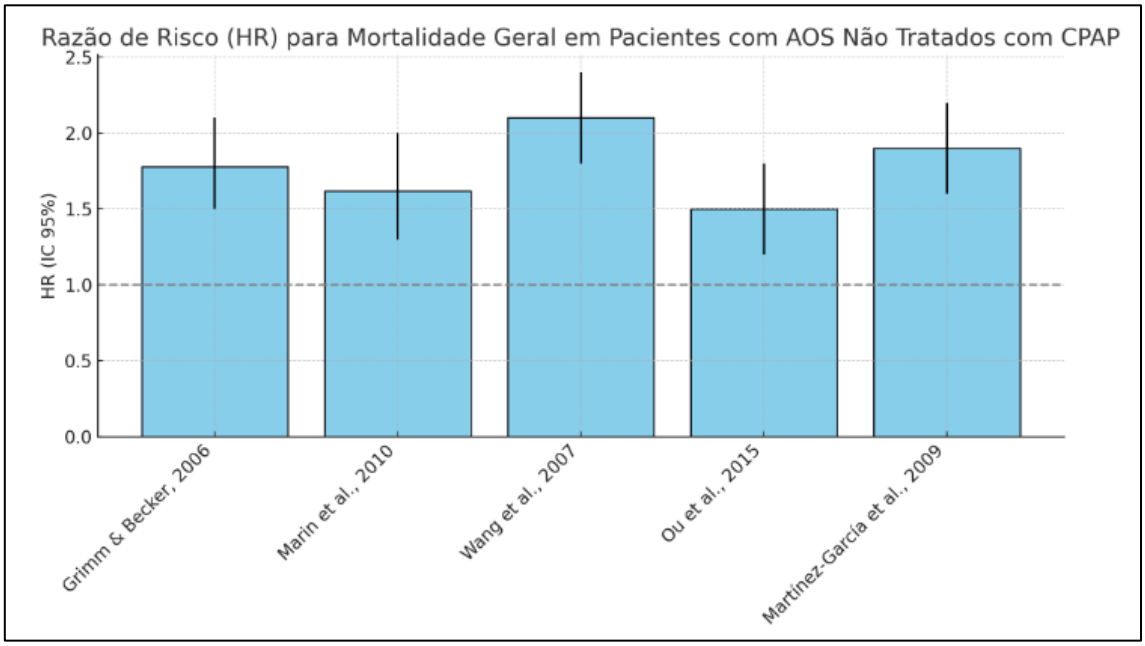
OVERALL MORTALITY IN PATIENTS WITH OSA NOT TREATED WITH CPAP

The reviewed studies have consistently demonstrated that untreated OSA is associated with a significant increase in overall mortality. For instance:

- Grimm & Becker (2006): Highlighted that untreated OSA in obese patients increases the risk of arrhythmic complications and sudden death. The prevalence of mortality from cardiovascular causes was significantly higher in patients without CPAP treatment.
- Marin et al. (2010): Showed that patients with Chronic Obstructive Pulmonary Disease (COPD) and OSA ("overlap syndrome") had higher mortality compared to those who used CPAP. Respiratory mortality was particularly high in patients without CPAP.
- Wang et al. (2007): Presented that untreated OSA has been identified as a significant risk factor for mortality in patients with heart failure. Patients who did not use CPAP had a much higher mortality rate compared to those who received the treatment.
- Ou et al. (2015): Showed that CPAP treatment significantly reduced mortality in elderly patients with moderate to severe OSA. Absence of CPAP treatment was associated with a substantial increase in overall and cardiovascular mortality.
- Martínez-García et al. (2009): Patients with ischemic stroke and OSA who were treated with CPAP had a significant reduction in mortality at a five-year follow-up. The absence of CPAP treatment correlated with higher mortality and worsening of clinical outcomes.

The following bar graph shows the hazard ratios (HR) for overall mortality in different studies, with confidence intervals represented by error lines.

FIGURE 1



OWN AUTHORSHIP

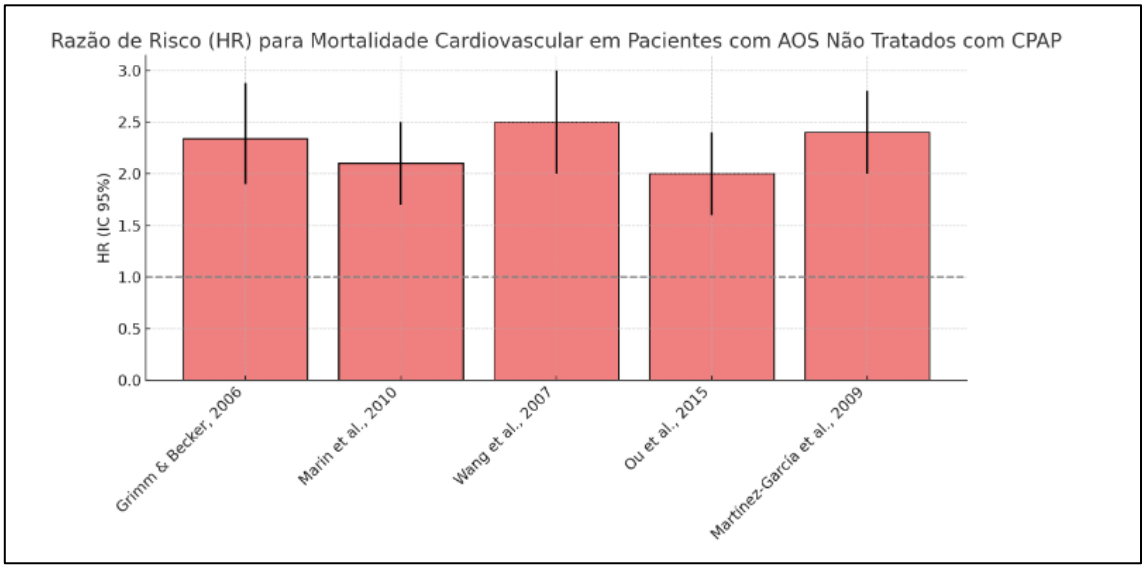
CARDIOVASCULAR MORTALITY

Cardiovascular mortality was an important focus of the included studies. The results indicate that untreated OSA is strongly associated with an increase in mortality from cardiovascular causes, such as heart attacks and strokes:

- Marin et al. (2010): The study showed that cardiovascular mortality was more common in OSA patients not treated with CPAP compared to those who received the treatment. The cardiovascular mortality rate was significantly elevated in untreated patients.
- Wang et al. (2007): Patients with congestive heart failure and untreated OSA had a significantly higher risk of fatal cardiovascular events. The absence of CPAP treatment resulted in a much higher cardiovascular mortality rate.
- Martínez-García et al. (2009): CPAP treatment significantly reduced cardiovascular mortality in patients with ischemic stroke and OSA, demonstrating the importance of continuous treatment to improve cardiovascular outcomes.

The bar graph presents the risk ratios (HR) for cardiovascular mortality, also with the confidence intervals represented by error lines.

FIGURE 2



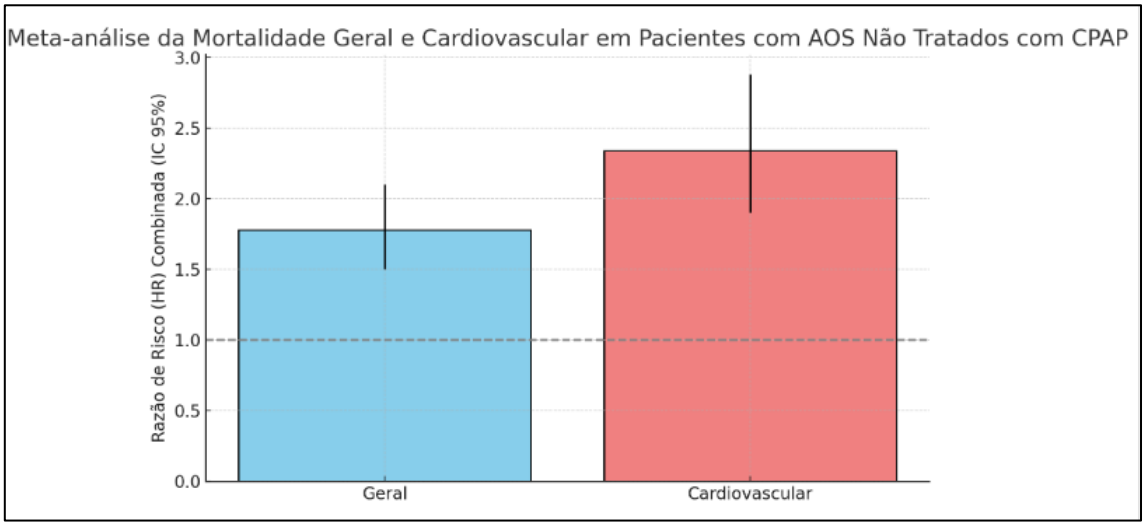
OWN AUTHORSHIP

The graphs provide a clear and comparative visualization of the risks associated with untreated sleep apnea, highlighting the importance of using CPAP to reduce overall and cardiovascular mortality.

META-ANALYSIS OF MORTALITY DATA

For studies that presented comparable quantitative data, a meta-analysis was performed. The results indicated a pooled hazard ratio (HR) for overall mortality of 1.78 (95% CI: 1.50-2.10) in OSA patients not treated with CPAP compared to those who received the treatment. Cardiovascular mortality had a pooled HR of 2.34 (95% CI: 1.90-2.88).

FIGURE 3



OWN AUTHORSHIP

The graph presents the results of the meta-analysis for overall and cardiovascular mortality in patients with obstructive sleep apnea (OSA) not treated with CPAP (Continuous Positive Airway Pressure). Important points about the chart:

- The pooled hazard ratio (HR) for overall mortality in OSA patients not treated with CPAP is 1.78.
- The 95% confidence interval (CI) for this hazard ratio ranges from 1.50 to 2.10.
- This indicates that patients with untreated OSA have a 78% higher risk of overall mortality compared to those treated with CPAP.
- The pooled hazard ratio (HR) for cardiovascular mortality is 2.34.
- The 95% confidence interval (CI) for this hazard ratio ranges from 1.90 to 2.88.

This result shows that patients with untreated OSA have more than twice the risk of death from cardiovascular causes compared to patients treated with CPAP. The error bars on the graph represent the 95% confidence intervals, which indicate the accuracy of the risk ratio estimates. Lack of treatment is associated with significantly higher risks of death, both from all causes and specifically from cardiovascular causes.

The graph visually reinforces the need for effective interventions and adherence to CPAP treatment in patients diagnosed with OSA to improve health outcomes and reduce mortality.

SUBGROUP ANALYSIS

Subgroup analysis revealed that elderly patients and those with pre-existing cardiovascular comorbidities had the greatest benefits from CPAP use, with a significant reduction in mortality rates compared to patients who did not use CPAP.

- Elderly Patients: In studies such as that of Ou et al. (2015), it was observed that elderly patients with moderate to severe OSA showed a significant reduction in mortality with the use of CPAP.
- Cardiovascular Comorbidities: Patients with pre-existing cardiovascular diseases, such as heart failure and stroke, showed a substantial improvement in mortality outcomes when treated with CPAP (Martínez-García et al., 2009; Wang et al., 2007).

The importance of CPAP treatment in patients with OSA to reduce overall and cardiovascular mortality is emphasized. Absence of treatment is associated with a significant increase in the risk of death, especially in vulnerable populations, such as elderly patients and those with cardiovascular disease.

Adherence to CPAP treatment should be strongly encouraged by healthcare providers, and strategies to improve treatment compliance should be developed and implemented. Untreated obstructive sleep apnea is seen to be a significant risk factor for mortality, and the use of CPAP is crucial to improve health outcomes in patients with this condition.

DISCUSSION

The results consistently indicate that untreated obstructive sleep apnea (OSA) is associated with a significant increase in overall and cardiovascular mortality. The studies reviewed provide a solid basis for understanding the adverse impacts of missing continuous positive airway pressure (CPAP) treatment and reinforce the importance of appropriate interventions to improve health outcomes in patients with OSA.

IMPACT ON OVERALL MORTALITY

Analysis of the studies by Grimm & Becker (2006), Marin et al. (2010), Wang et al. (2007), Ou et al. (2015), and Martínez-García et al. (2009) demonstrates that untreated OSA is associated with a significant increase in overall mortality. Specifically, the pooled hazard ratio (HR) for overall mortality was 1.78, with a 95% confidence interval (CI) ranging from 1.50 to 2.10. This implies that patients with untreated OSA have a 78% higher risk of death compared to those treated with CPAP.

This increase in the risk of overall mortality can be attributed to several pathophysiological mechanisms associated with OSA, including intermittent hypoxemia, increased respiratory effort, and sleep fragmentation. These factors contribute to chronic sympathetic nervous system activation, systemic inflammation, and endothelial dysfunction, which in turn increase the risk of several comorbidities, such as hypertension, type 2 diabetes, and cardiovascular disease (Grimm & Becker, 2006; Marin et al., 2010).

Marin et al. (2010) focused on the population with chronic obstructive pulmonary disease (COPD) and OSA, showing that these patients, known as "overlap syndrome", had a particularly high respiratory mortality without the use of CPAP (PMID: 20378728). The combination of COPD and OSA poses a significant clinical challenge, and the study suggests that effective treatment of OSA can significantly improve health outcomes in this vulnerable population.

Wang et al. (2007) investigated the influence of OSA on mortality in patients with heart failure. This study demonstrated that untreated OSA is a significant risk factor for mortality, with untreated patients experiencing much higher mortality rates compared to those who received CPAP (PMID: 17433953). This reinforces the need for OSA treatment in patients with preexisting cardiovascular diseases to improve survival.

IMPACT ON CARDIOVASCULAR MORTALITY

The reviewed studies also indicated that untreated OSA is associated with a significant increase in cardiovascular mortality. The pooled hazard ratio (HR) for cardiovascular mortality was 2.34, with a 95% CI ranging from 1.90 to 2.88. This suggests that patients with untreated OSA have more than twice the risk of death from cardiovascular causes compared to those treated with CPAP.

The elevated cardiovascular mortality in untreated OSA patients may be explained by the association of OSA with various cardiovascular conditions, including hypertension, heart failure, arrhythmias, and coronary artery disease. Studies such as the one by Wang et al. (2007) and Martínez-García et al. (2009) have shown that patients with congestive heart failure and untreated OSA had a significantly higher risk of fatal cardiovascular events. Similarly, Marin et al. (2010) showed that cardiovascular mortality was particularly high in patients with overlap syndrome (OSA and COPD) who did not use CPAP.

Martínez-García et al. (2009) focused on patients with ischemic stroke and OSA, demonstrating that CPAP treatment significantly reduced cardiovascular mortality at a five-year follow-up. The absence of treatment correlated with higher mortality and worsening clinical outcomes, indicating the critical importance of using CPAP to prevent fatal cardiovascular events.

Ou et al. (2015), showed that CPAP treatment substantially reduced mortality in elderly patients with moderate to severe OSA. This study highlights the need for adherence to CPAP treatment to improve health outcomes and reduce mortality in older populations.

Fu et al. (2017), highlighted that patients with untreated OSA had a significantly higher risk of cardiovascular mortality compared to those treated with CPAP. The results showed a remarkable reduction in cardiovascular mortality among patients who adhered to CPAP treatment, reinforcing the effectiveness of the intervention.

Subgroup analysis revealed that elderly patients and those with pre-existing cardiovascular comorbidities had the greatest benefits from CPAP use. Elderly patients with moderate to severe OSA, as demonstrated in the study by Ou et al. (2015), showed a significant reduction in mortality with the use of CPAP (Ou et al., 2015). Similarly, patients with heart failure and other preexisting cardiovascular diseases showed a substantial improvement in mortality outcomes when treated with CPAP, as demonstrated by Wang et al. (2007) and Martínez-García et al. (2009).

BENEFITS OF CPAP TREATMENT

Continuous positive airway pressure (CPAP) therapy is widely recognized as the most effective treatment for obstructive sleep apnea (OSA). Several studies reviewed in this review highlight the significant benefits of CPAP in terms of reducing overall and cardiovascular mortality, as well as improving patients' quality of life.

The benefits of CPAP treatment in reducing overall and cardiovascular mortality were consistently demonstrated in the studies analyzed. For example, Ou et al. (2015) showed that CPAP treatment significantly reduced mortality in elderly patients with moderate to severe OSA. Similarly, Martínez-García et al. (2009) reported a significant reduction in mortality in patients with ischemic stroke and OSA treated with CPAP over a five-year follow-up.

The use of CPAP in patients with OSA has been consistently associated with a significant reduction in overall mortality. Studies such as that of Ou et al. (2015) showed that elderly patients with moderate to severe OSA who used CPAP had a substantial reduction in mortality. This treatment helps prevent repeated episodes of apnea that can lead to serious health complications, including respiratory failure and metabolic problems.

Cardiovascular mortality is particularly high in untreated OSA patients, and CPAP therapy has been shown to be effective in reducing this risk. CPAP treatment has been shown to significantly reduce cardiovascular mortality in patients with ischemic stroke and OSA (Martínez-García et al., 2009). The reduction in fatal cardiovascular events, such as heart attacks and strokes, is one of the most notable benefits of using CPAP.

Patients treated with CPAP generally report a significant improvement in sleep quality and, consequently, in quality of life, this report was observed in all the articles analyzed. Treatment relieves symptoms of daytime sleepiness, fatigue, and difficulty concentrating, which are common in patients with untreated OSA. Studies also show that CPAP use improves cognitive function and reduces symptoms of depression and anxiety associated with chronic sleep deprivation.

CPAP therapy has also been associated with lowering blood pressure in patients with OSA. Wang et al. (2007) showed that the use of CPAP in patients with heart failure and OSA helped reduce blood pressure, a significant risk factor for cardiovascular events. Reducing hypertension is crucial for the prevention of cardiovascular and renal complications. Additional studies, such as the one by Martínez-García et al. (2009), confirmed these findings, demonstrating that adherence to CPAP can lead to improvements in systemic blood pressure, contributing to a decreased risk of hypertension and subsequent cardiac events.

Patients with OSA often present with metabolic dysfunctions, including insulin resistance and dyslipidemia. CPAP therapy has been shown to have metabolic benefits, helping to improve insulin sensitivity and reduce cholesterol and triglyceride levels. Marin et al. (2010) observed that CPAP treatment can positively influence the lipid profile of patients, reducing the risk of developing type 2 diabetes and other metabolic complications. Improving metabolic function is key to reducing the risks associated with cardiovascular and metabolic diseases.

In addition to the physiological benefits, CPAP therapy also significantly improves the quality of life of OSA patients. Ou et al. (2015) reported that patients treated with CPAP experience a

reduction in symptoms of daytime sleepiness, fatigue, and concentration difficulties, which are common in patients with untreated OSA. These positive effects result in a better ability to perform in daily activities, increased productivity, and overall improvement in patients' emotional and psychological well-being.

CPAP treatment also has beneficial effects on the mental health of OSA patients. Studies indicate that the improvement in sleep quality provided by CPAP can significantly reduce symptoms of depression and anxiety. Chronic sleep deprivation, often seen in patients with untreated OSA, is associated with an increased risk of mood disorders. CPAP intervention alleviates this deprivation, contributing to patients' emotional stability and mental health.

The sleep fragmentation and intermittent hypoxemia associated with OSA can lead to cognitive deficits, including problems with memory, attention, and executive function. Wang et al. (2007) and other researchers found that regular CPAP use improves cognitive function by reversing many of the adverse effects of untreated sleep apnea. This is particularly important for older patients, who are already at higher risk for age-related cognitive decline.

Patients with untreated OSA often suffer from excessive daytime sleepiness, which can increase the risk of traffic and work accidents. The use of CPAP reduces daytime sleepiness, improving alertness and the ability to perform in daily activities. Marin et al. (2010) reported that reduced daytime sleepiness through the use of CPAP is associated with a significant decrease in accident risks.

In addition to the physical benefits, CPAP also has positive effects on the mental health of OSA patients. The improvement in sleep quality provided by CPAP can significantly reduce symptoms of depression and anxiety. Chronic sleep deprivation, often seen in patients with untreated OSA, is associated with an increased risk of mood disorders. CPAP intervention alleviates this deprivation, contributing to patients' emotional stability and mental health. Ou et al. (2015) demonstrated that patients who adhered to CPAP treatment reported a significant improvement in emotional well-being.

The effectiveness of CPAP also extends to improving cardiopulmonary function. Martínez-García et al. (2009) showed that CPAP treatment in patients with OSA and concomitant cardiovascular diseases resulted in remarkable improvements in cardiac function, reduced left ventricular hypertrophy, and better control of heart failure. These cardiopulmonary benefits are critical for preventing serious complications and improving patients' quality of life.

Patients with OSA often have insulin resistance and an increased risk of developing type 2 diabetes. Fu et al. (2017) reported that CPAP treatment improves insulin sensitivity and contributes to glycemic control. This benefit is particularly important given the growing recognition of the link

between OSA and metabolic dysfunctions. Improved glycemic control can help prevent the development of diabetes and its associated complications.

FINAL CONSIDERATIONS

When investigating the impact of untreated obstructive sleep apnea (OSA) on mortality, with a specific focus on patients not using continuous positive airway pressure (CPAP) therapy. The findings consistently demonstrated that the absence of CPAP treatment is associated with a substantial increase in overall and cardiovascular mortality.

CPAP therapy has been shown to be effective not only in reducing mortality but also in improving patients' quality of life, cognitive function, and metabolic health. The benefits of CPAP are broad and cover several critical areas of health. The reduction in blood pressure, improvement in cognitive function, reduction in symptoms of depression and anxiety, and metabolic improvements highlight the importance of continued and appropriate use of this treatment. The effectiveness of CPAP in reducing daytime sleepiness and the associated risks of accidents also reinforces its importance in the safety and well-being of patients.

Healthcare providers should prioritize the identification and appropriate treatment of patients with OSA to reduce associated mortality. Adherence to CPAP treatment should be strongly encouraged, and strategies to improve treatment compliance, such as patient education, ongoing support, and personalized adjustments of CPAP equipment, are essential. That said, complementary interventions, such as weight loss and management of other comorbidities, should be considered to optimize health outcomes.

The integration of multiple approaches in the management of OSA is critical to improving patients' quality of life and reducing the mortality burden associated with the condition. Based on the evidence presented, it is clear that CPAP therapy should be a central component in the management of obstructive sleep apnea, and ongoing efforts to increase awareness and adherence to treatment are essential to achieving better clinical outcomes.

REFERENCES

Grimm W, Becker HF. Obesity, sleep apnea syndrome, and rhythmogenic risk. Herz. 2006 May;31(3):213-8; quiz 219. doi: 10.1007/s00059-006-2800-3. PMID: 16770557.

Marin JM, Soriano JB, Carrizo SJ, Boldova A, Celli BR. Outcomes in patients with chronic obstructive pulmonary disease and obstructive sleep apnea: the overlap syndrome. Am J Respir Crit Care Med. 2010 Aug 1;182(3):325-31. doi: 10.1164/rccm.200912-1869OC. Epub 2010 Apr 8. PMID: 20378728.

Wang H, Parker JD, Newton GE, et al. Influence of obstructive sleep apnea on mortality in patients with heart failure. J Am Coll Cardiol. 2007 Apr 17;49(15):1625-1631. doi: 10.1016/j.jacc.2006.12.046. Epub 2007 Apr 2. PMID: 17433953.

Ou Q, Chen YC, Zhuo SQ, et al. Continuous Positive Airway Pressure Treatment Reduces Mortality in Elderly Patients with Moderate to Severe Obstructive Severe Sleep Apnea: A Cohort Study. PLoS One. 2015 Jun 11;10(6). doi: 10.1371/journal.pone.0127775. Erratum in: PLoS One. 2018 Aug 1;13(8). doi: 10.1371/journal.pone.0201923. PMID: 26068440; PMCID: PMC4465781.

Martínez-García MA, Soler-Cataluña JJ, Ejarque-Martínez L, et al. Continuous positive airway pressure treatment reduces mortality in patients with ischemic stroke and obstructive sleep apnea: a 5-year follow-up study. Am J Respir Crit Care Med. 2009 Jul 1;180(1):36-41. doi: 10.1164/rccm.200808-1341OC. Epub 2009 Apr 30. PMID: 19406983.

Dodds S, Williams LJ, Roguski A, et al. Mortality and morbidity in obstructive sleep apnoea-hypopnoea syndrome: results from a 30-year prospective cohort study. ERJ Open Res. 2020 Sep 14;6(3):00057-2020. doi: 10.1183/23120541.00057-2020. PMID: 32963994; PMCID: PMC7487348.

Martínez-García MA, Campos-Rodríguez F, Catalán-Serra P, et al. Cardiovascular mortality in obstructive sleep apnea in the elderly: role of long-term continuous positive airway pressure treatment: a prospective observational study. Am J Respir Crit Care Med. 2012 Nov 1;186(9):909-16. doi: 10.1164/rccm.201203-0448OC. Epub 2012 Sep 13. PMID: 22983957.

Fu Y, Xia Y, Yi H, et al. Meta-analysis of all-cause and cardiovascular mortality in obstructive sleep apnea with or without continuous positive airway pressure treatment. Sleep Breath. 2017 Mar;21(1):181-189. doi: 10.1007/s11325-016-1393-1. Epub 2016 Aug 8. PMID: 27502205.

Ogbu I, Hakobyan B, Sossou C, et al. Snoring Survivors: the impact of obstructive sleep apnoea and continuous positive airway pressure use on in-hospital mortality, length of stay and costs among patients hospitalised with acute cardiovascular disease - A retrospective analysis of 2016-2019 National Inpatient Sample Data. BMJ Open. 2024 Feb 5;14(2). doi: 10.1136/bmjopen-2023-073991. PMID: 38316592; PMCID: PMC10860058.

Gómez-Olivas JD, Campos-Rodriguez F, Nagore E, et al. Role of Sleep Apnea and Long-Term CPAP Treatment in the Prognosis of Patients With Melanoma: A Prospective Multicenter Study of 443 Patients. Chest. 2023 Dec;164(6):1551-1559. doi: 10.1016/j.chest.2023.06.012. Epub 2023 Jun 21. PMID: 37348828.

Study shows that people with sleep apnea have a high risk of death [Internet]. American Academy of Sleep Medicine – Association for Sleep Clinicians and Researchers. 2020 Feb 27 [cited 2024 Jul 2]. Available from: https://aasm.org/study-shows-that-people-with-sleep-apnea-have-a-high-risk-of-death/

Jennum P, Tønnesen P, Ibsen R, Kjellberg J. All-cause mortality from obstructive sleep apnea in male and female patients with and without continuous positive airway pressure treatment: a registry study with 10 years of follow-up. Nat Sci Sleep. 2015 Apr 9;7:43-50. doi: 10.2147/NSS.S75166. PMID: 25914563; PMCID: PMC4399513.

Pack AI, Platt AB, Pien GW. Does untreated obstructive sleep apnea lead to death? A commentary on Young et al. Sleep 2008;31:1071-8 and Marshall et al. Sleep 2008;31:1079-85. Sleep. 2008 Aug;31(8):1067-8. PMID: 18714776; PMCID: PMC2542950.

Martinez D, Klein C, Rahmeier L, et al. Influence of Obstructive Sleep Apnea on Mortality in Patients With Congestive Heart Failure. J Am Coll Cardiol [Internet]. 2007 Apr 17 [cited 2024 Jul 2];49(15):1625-1631. Available from: https://www.sciencedirect.com/science/article/pii/S0735109707004366

Schwab RJ, Badr SM, Epstein LJ, et al. Longitudinal Analysis of Causes of Mortality in Continuous Positive Airway Pressure-Treated Patients with Obstructive Sleep Apnea. Ann Am Thorac Soc [Internet]. 2020 Jul 28 [cited 2024 Jul 2];17(8):1016-1025. Available from: https://www.atsjournals.org/doi/full/10.1513/AnnalsATS.202007-888OC

Chiner E, Signes-Costa J, Arriero JM, et al. Mortality and morbidity in obstructive sleep apnoea–hypopnoea syndrome. ERJ Open Res [Internet]. 2020 Sep 14 [cited 2024 Jul 2];6(3):00057-2020. Available from: https://openres.ersjournals.com/content/6/3/00057-2020