[Original Research]

CHEST

Surgical Treatment of OSA on Cardiovascular Outcomes

A Systematic Review

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BACKGROUND: OSA is an increasingly prevalent clinical problem with significant effects on quality of life and cardiovascular risk. Surgical therapy represents an important treatment for those unable to use positive airway pressure. This systematic review examines the available cardiovascular risk reduction data for the surgical treatment of OSA.

METHODS: A comprehensive literature search was performed. Articles were included if they met the following criteria: (1) the sample population consisted of adults (age ≥ 18 years); (2) OSA was diagnosed according to a sleep study; (3) surgical intervention was performed for OSA; and (4) one or more physical or biochemical cardiovascular and/or cerebrovascular variables was measured preoperatively and at ≥ 14 days' postoperatively.

RESULTS: Thirty-three articles were included. The majority of studies were case series and cohort studies (42% and 44%, respectively), with wide-ranging follow-up periods (15 days-9 years) and sample sizes (range, 6-10,339; median, 34). The following classes of surgical intervention were examined: pharyngeal surgery (n = 23), tracheostomy (n = 6), maxillomandibular advancement (n = 3), and hypoglossal nerve stimulation (n = 1). In total, 19 outcome measures were assessed. Tracheostomy was most consistently associated with improvement in cardiovascular end points. Pharyngeal surgeries (eg, uvulopalatopharyngoplasty) were variably associated with improvement in cardiovascular end points.

CONCLUSIONS: The published literature examining cardiovascular end points following surgical treatment of OSA is limited and generally of poor quality. However, available data from mainly small and observational studies suggest that surgical treatment of OSA may provide improvement in some cardiovascular end points. Larger, randomized, and prospective trials with more rigorous study designs are needed.

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ABBREVIATIONS: AHI = apnea-hypopnea index; CAD = coronary artery disease; CRP = C-reactive protein; LAUP = laser-assisted uvulopalatoplasty; MMA = maxillomandibular advancement; PAP = positive airway pressure; RVEF = right ventricular ejection fraction; TNF = tumor necrosis factor; UPPP = uvulopalatopharyngoplasty

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OSA is a disorder characterized by repetitive collapse of the upper airway during sleep that leads to nocturnal hypoxemia and recurrent arousals.[1] In addition to decreased neurocognitive performance from the recurrent nocturnal arousals, there is an increased risk of fatal and nonfatal cardiovascular events as well as heightened all-cause mortality in patients with moderate to severe OSA.[2,3] As the prevalence of moderate to severe OSA rises, currently estimated at 10% to 17% of men and 3% to 9% of women,[4] untreated OSA represents a looming public health risk for cardiovascular disease.

Positive airway pressure (PAP) is the first-line therapy for adults with moderate to severe OSA.[5] This therapy has been shown to be highly efficacious in improving polysomnographic parameters, symptoms, and quality of life.[6] PAP has also been shown to reduce risk of cardiovascular events (eg, cerebrovascular accident, myocardial infarction), hypertension, and death.[2,3,7] In addition to clinical outcomes, PAP therapy reportedly improves intermediate or surrogate cardiovascular end points, including measures of sympathetic activity, vascular function, and systemic inflammation.[8-10]

Patient outcomes with PAP are diminished by poor adherence with the device,[11-13] as < 50% of patients in clinical practice adequately use PAP.[14,15] Due to high levels of nonadherence, alternative treatment options are often sought by both patients and providers. Oral appliance therapy and upper airway surgery represent two such options. Oral appliances are orthodontic retainers worn during sleep that maintain the lower jaw in a forward position, thereby stabilizing the pharyngeal airway. Oral appliances are often effective in the treatment of OSA, improving both polysomnographic and clinical symptoms.[16] A meta-analysis of the effect of oral appliance therapy on blood pressure found consistent improvements in blood pressure, similar to the magnitude achieved with PAP therapy.[17]

No standard surgical procedure exists for OSA given the variations in anatomy, sleep apnea severity, patient comorbidities, and patient preference. Surgery can be classified into the following categories: soft tissue (eg, uvulopalatopharyngoplasty [UPPP]), skeletal (eg, maxillomandibular advancement [MMA]), tracheostomy, and hypoglossal nerve stimulation. Although several studies have examined various end points for assorted surgical approaches, no study to date has systematically reviewed the existing data. The purpose of the present study was to examine the available literature related to cardiovascular risk reduction for surgical therapy for OSA.

Materials and Methods

The protocol for this systematic review was developed a priori, consistent with the Preferred Reporting Items for Systematic Review checklist. The study did not require approval from the institutional review board because no new data were collected, and all included studies had been published previously.

Search Strategy

The search strategy was developed by the study authors in collaboration with an experienced medical librarian. A comprehensive search of the literature was performed by using the databases of PubMed, Embase, SCOPUS, the Cochrane Library, BioMed Central, and Web of Science from inception to July 2016. No restrictions on language of publication or study design were applied during the database searches.

To identify the maximum number of relevant articles, a broad search strategy was employed using the following key words and variations of each: *sleep apnea, sleep disordered breathing, surgery, hyoid suspension, genioglossal advancement, hypoglossal nerve stimulation, maxillomandibular advancement, tracheostomy, uvulopalatopharyngoplasty, blood pressure, heart rate variability, flow mediated dilation, cardiopulmonary exercise testing, cardiac morphology, cardiovascular, arrhythmias, nitric oxide, TNF-alpha, C-reactive protein, matrix metalloproteinase 9, troponin, catecholamines, natriuretic peptide, myocardial infarction,* and *cerebrovascular disease*. Bibliographies of all selected articles and sleep surgery review articles were also reviewed.

Study Selection Process

Articles were included if they met the following criteria: (1) the sample population consisted of adults (age ≥ 18 years); (2) OSA was diagnosed according to a sleep study; (3) surgical intervention was performed for OSA; (4) subjects served as their own control subjects (pretreatment vs posttreatment) or were compared with a separate control group; and (5) one or more of the following physical or biochemical cardiovascular and/or cerebrovascular variables was measured preoperatively and at ≥ 14 days' postoperatively: blood pressure, heart rate variability, flow-mediated dilation, arterial stiffness or thickness, cardiopulmonary exercise testing, cardiac morphology or function, cerebrovascular event (eg, stroke, transient ischemic attack), myocardial infarction, arrhythmia, cardiovascular or cerebrovascular mortality, nitric oxide derivatives, tumor necrosis factor-α (TNF-α), C-reactive protein (CRP), matrix metalloproteinase-9, troponins, brain natriuretic peptide, and urinary catecholamines.

Screening of the titles and abstracts of the retrieved studies for relevance was performed by two reviewers (T. R. H. and R. C. D.), and discrepancies were resolved by consensus. Articles published in languages other than English were excluded after the title and abstract screen. Structured abstracts and posters were also excluded at this stage if no full publication was available. Two reviewers (T. R. H. and M. S. O.) reviewed the remaining articles in their entirety for consistency with the study protocol. Disputes were resolved by a third reviewer (R. C. D.).