



Post-Obstructive Pulmonary Edema (POPE) and Negative Pressure Pulmonary Edema (NPPE) After Upper Airway Surgery: A Systematic Review and Meta-analysis

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Abstract

Objectives: To provide an up-to-date systematic review and critical appraisal of case reports and performed studies evaluating post obstructive pulmonary edema (POPE) and negative pressure pulmonary edema (NPPE) in patients after upper airway surgery.

Study Design: Systematic Review and meta-analysis

Methods: Searches were performed from inception through October 11, 2016 of PubMed/MEDLINE, EMBASE, Scopus, Web of Science, and the Cochrane Library. We collected information on patient demographics, preoperative medications, surgical procedures, medical histories, and treatment of POPE.

Results: Fifty-one manuscripts, 113 patients, met criteria and reported postoperative treatment outcomes and individual patient data for 77 patients. Average age was 34±20.1 years (range 6 months-73 years) with 56.9% male. Majority of POPE were type I (68.8%) compared to type II (31.2%). The most common operative procedures included variations of tonsillectomy and septorhinoplasty. Treatment included 63.6% of patients were reintubated, 75.3% were treated with diuretics, and only 24.7% were treated with steroids. There was no difference in length of stay between patients who did and did not receive steroids. The majority of patients (58.5%) were discharged within three days of complication, however, notably 22.6% had hospital stays greater than a week.

Conclusions: The majority of the published literature shows heterogeneity within clinical studies, lack of controlled data, and lack of prospective studies. However, post-obstructive pulmonary edema can occur after various upper airway surgeries, and a keen awareness of the both types of POPE can help with early recognition and mitigate potentially devastating effects of this rare complication.

Introduction

Post-obstructive pulmonary edema (POPE) and negative pressure pulmonary edema (NPPE) are both types of acute non-cardiogenic pulmonary edema. The overall incidence of POPE is less than 0.1% in all surgeries performed under general anesthesia. ^{1,2} In patients with upper airway obstruction requiring intubation, the incidence of POPE is reported to be 11-12%. ^{3,4}

There are two types of POPE to include type I, which follows attempted inspiration against a sudden upper airway obstruction whereas type II develops after surgical relief of chronic upper airway obstruction. ^{5,6} In type I, the elevated negative intrapleural pressure and increase in transpulmonary blood volume elevates pulmonary venous hydrostatic pressures which lead to transudation of fluid into lung interstitium exacerbated by increased pulmonary vascular resistance secondary to hypoxemia. ⁷⁻⁹ In type II, the precipitous loss of auto-positive pressure causes fluid shift to lung interstitium. ⁷ Common etiologies for type I include laryngospasm, epiglottitis, foreign body, endotracheal tube obstruction, laryngeal tumor, goiter, and postoperative vocal cord paralysis. Type II occurs after adenotonsillectomy, laryngeal mass resection, or reduction of hypertrophic redundant uvula. ⁶ The most common cause of POPE is acute upper airway obstruction associated with laryngospasm. ^{2,10}

Methods and Materials

Authors S.A.S., J.S., C.L.P., J.N. and M.C. independently searched PubMed/MEDLINE, Scopus, Web of Science, and the Cochrane Library from inception through April 5, 2017. For a study to be included in this review, the following inclusion criteria had to be met (using PICOS): (1) **Patients:** subjects had to be otolaryngology patients (2) **Intervention:** who underwent upper airway surgery or other otolaryngologic procedure, (3) **Comparison:** pre- and post-operative data, (4) **Outcomes:** quantitative postoperative outcomes had to be reported with individual patient data, and (5) **Study design:** case reports and case series studies in any languages. We excluded studies review articles, studies reporting qualitative data only, cardiogenic pulmonary edema and those studies reporting patients who did not have otolaryngology intervention.

Results

There were 53 patients with Type I POPE and 23 patients with Type II POPE for whom individual patient data was available for analysis. On univariate analysis, the following patient characteristics were found to be significantly different between the Type I and Type II POPE groups: age ($p=0.0326$) and patient weight ($p=0.0100$). The Type II POPE group was composed of a younger cohort of patients as compared to Type I POPE (24.2 ± 21.2 years vs. 35.5 ± 20.1 years, mean± SD). In addition, patients in the Type II POPE Group were also found to have significantly lower weight as compared to the Type I POPE Group (25.4 ± 15.4 kg vs. 64.6 ± 24.5 kg). On multivariate analysis with nominal logistic fit regression considering the factors “age” and “weight”, only the factor “weight” remained statistically significant as a risk factor for Type I vs. Type II POPE, $p=0.0148$. See figure 1.

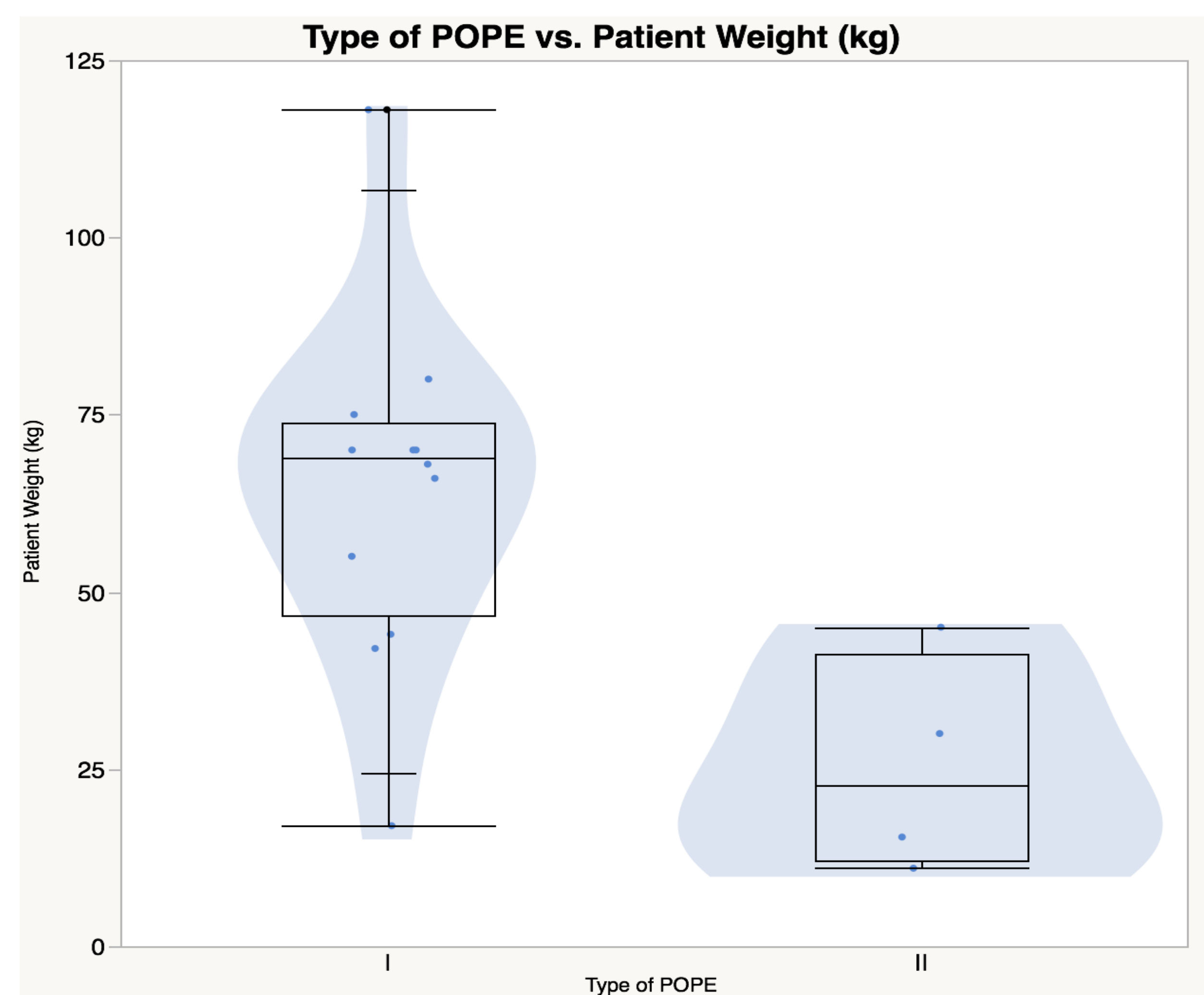


Figure 1. Quantile box plot of patient weight by type of POPE.

Discussion

Type I and Type II POPE have similar presentations and treatment. However, a difference in age and weight seems to be notable between POPE type I and type II cohorts. Analysis of the included studies revealed a significant dichotomy between patients who suffer from the two types of POPE. The type II POPE group was composed of a younger cohort of patients and significantly lower weight as compared to the type I POPE group. This finding was consistent with the significant difference observed between the two groups with respect to precipitating factor at the time of the acute POPE event. Relief of obstruction was universally related to type II POPE, often seen in post-adenotonsillectomy in children.

There are a few exceptional cases that are worth mentioning. The altered physiology of pregnancy increases the likelihood of pulmonary edema. Congenital abnormalities can increase such as in a case of a child with Poland-Moebius syndrome after adenotonsillectomy.

Conclusions

The majority of the published literature shows heterogeneity within clinical studies, lack of controlled data, and lack of prospective studies. However, post-obstructive pulmonary edema can occur after various upper airway surgeries, and a keen awareness of the both types of POPE can help with early recognition and mitigate potentially devastating effects of this rare complication.

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