



## Article Appraisal

**Article:** Apneic oxygenation reduces hypoxemia during endotracheal intubation in the pediatric emergency department. American Journal of Emergency Medicine 2018.

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### Background and Study Objective(s):

Apneic oxygenation is now a common practice during endotracheal intubation (ETI), and is widely believed to be helpful in preventing hypoxemia during the apneic period following administration of rapid sequence intubation drugs. However studies of apneic oxygenation in the adult population have shown mixed results. For example a recent randomized controlled trial, the ENDAO trial (reviewed in DEM Journal Club in April 2018), found no difference in the incidence of hypoxemia from apneic oxygenation during standard ETI. Few studies have been done evaluating the use of apneic oxygenation in children. The aim of this study was to determine if the use of apneic oxygenation was associated with a reduced incidence of hypoxemia in a pediatric population.

### Study Design:

The investigators conducted a retrospective pre/post observational study using Registry data from a single Level 1 trauma tertiary care children's hospital in Nashville, Tennessee. The Registry was comprised of data collected from all endotracheal intubations that occurred in the Pediatric ED. Data was extracted by chart review and standardized data collection forms were completed using the Registry data. The intervention and comparison groups were defined by time periods before and after when apneic oxygenation (AO) was deemed by the authors to be standard of practice and routinely performed at the study site. Specifically, the pre-AO era was comprised of cases between January and June 2011 (6 months) and the AO era was comprised of cases between August 2014 and March 2017 (32 months). Inclusion criteria were patients less than 22 years of age who underwent ETI in the ED. Exclusion criteria were patients receiving ongoing CPR and those in whom it was not clear whether or not apneic oxygenation was applied.

152 cases were screened. 14 cases from the AO era were moved to the pre-AO era group as it was clear from the chart they had not received AO. 3 cases were excluded as the patient had received CPR. This resulted in a final sample size of 59 patients analysed in the pre-AO group and 90 patients in the AO era group. The sample size was calculated with 80% power to detect a difference in SpO<sub>2</sub> of 13% or more between the time periods.

The primary outcomes were the incidence of hypoxemia defined as an SpO<sub>2</sub> of <90% as well as lowest median SpO<sub>2</sub>. This non-parametric data was analysed using the Wilcoxon Rank Sum test for continuous data and the Chi squared

test for categorical data. A multivariate regression model was fit to evaluate the association between covariates of interest and hypoxemia. And a sensitivity analysis was conducted to determine sensitivity of inclusion of the 14 AO era patients that did not receive AO in the pre-AO era group.

## Results:

The median SpO<sub>2</sub> during ETI was significantly lower in the pre-AO era group compared to the AO era group (93% vs. 100%). Almost 50% of the patients in the pre-AO era group experienced hypoxemia (defined as an SpO<sub>2</sub> <90%) during ETI, compared to less than 25% of patients in the AO era group. The authors also looked at the lowest SpO<sub>2</sub> that occurred during ETI. The 25th percentile SpO<sub>2</sub> was <69% in the pre-AO era group compared to a 25th percentile SpO<sub>2</sub> of <95% in the AO era group. These findings were all highly statistically significant. The logistic regression model found that patients in the AO era group had an odds ratio of 0.3 for hypoxemia. Older patients and those with a higher pre-ETI SpO<sub>2</sub> also had decreased odds of hypoxemia (0.8 and 0.9, respectively). Finally, each additional intubation attempt was associated with an adjusted odds ratio of 4.0 for hypoxemia.

Notably, there were significant differences in the patient characteristics and intubation factors between the pre-AO era and AO era groups. Gender was similar but patients were younger in the pre-AO cohort and included more patients with a history of prematurity (18% vs 8%); more patients were intubated for altered mental status in the AO era group; and there were differences in the level of training of proceduralist between groups. Finally, and perhaps most importantly, there was also a large difference in the method of intubation between eras—videolaryngoscopy was used at a much greater rate in the AO era group (31% vs 10%). Pre-ETI SpO<sub>2</sub> was not appreciably different.

## Validity of Results:

The consensus of Journal Club attendees was that the study methodology, and major differences between the pre/post populations for factors other than AO, posed significant limitations in interpretation of the results. The intervention and control groups were collected at different time periods. As a result, whether the clear difference in hypoxemia between the groups was related to a difference in the practice pattern or patient populations seen in the ED during these time periods, and whether apneic oxygenation was the sole reason responsible for this difference, is impossible to determine. The striking difference in the rate of accrual of patients during the two periods (almost 3-fold faster in the much shorter pre AO period), was noted by Journal Club attendees (but not the authors), and is further potential evidence of differences over time (secular trends), and could have arisen from such things as an increase in prehospital intubations and/or increased use of non-invasive ventilation. The authors acknowledged some of these potential confounding factors, but they are impossible to adjust for with this design. Of note, videolaryngoscopy was used more frequently in the AO era group, but the duration of intubation attempt was not reported, and it is conceivable that faster intubation times associated with VL (and not the use of AO) could explain all the findings. Moreover, the potential for unrecognized confounders, such as the method of pre-oxygenation or the rapidity of using BVM and regrouping when saturations drop (which may have changed over the study period) continues to exist, and these secular trends could also account for some or all of the study findings.

## Generalizability of Results:

This study was conducted at a single centre in Nashville, Tennessee. The consensus of Journal Club attendees was that the patient populations (such as the incidence of severe obesity) and practice patterns in this hospital could easily differ significantly from those within a Canadian health care system. As a result, it is difficult to determine how generalizable the study results are.

## The Bottom Line:

This study was an observational study that attempted to determine if apneic oxygenation reduced the incidence of hypoxemia during endotracheal intubation in a pediatric population. Children have a smaller functional residual capacity and higher oxygen consumption, supporting the hypothesis that they may derive greater benefit from an intervention that prolongs safe apnea time. Unfortunately, the significant limitations in the methodology of this study, and the discordance of the findings compared to the ENDAO RCT (albeit in an adult population), undermine confidence in the conclusions the authors reached and asserted in their title. An interesting discussion at Journal Club ensued, reflecting on the small downside and ease of the use of AO in a tightly run large ED, in contrast to the complexity of advocating this in a more resource poor environment and providers with less experience in pediatric

intubation. While the general sentiment of Journal Club attendees was that they would continue to use AO during pediatric intubations, this study was felt to provide minimal if any evidence to support such an approach.