This year there have been thousands of research trials and articles about mechanical ventilation that makes the selection of important articles very difficult

We chose some studies/articles that might have educational and clinical significance

We represent the abstract of those articles along a brief commentary and thoughts by our editorial team

We do not recommend depending on our comments but reading and critiquing the study/paper yourself and make your own decision

- **Alveolar mechanics: A new concept in respiratory monitoring**
- **Oxygen-Saturation Targets for Critically Ill Adults Receiving Mechanical Ventilation**
- **Spontaneous-Breathing Trials with Pressure-Support Ventilation or a T-Piece**
- **Effect of Minimally Invasive Surfactant Therapy vs Sham Treatment on Death or Bronchopulmonary Dysplasia in Preterm Infants with Respiratory Distress Syndrome: The OPTIMIST-A Randomized Clinical Trial**
- **Effect of Noninvasive Respiratory Strategies on Intubation or Mortality Among Patients with Acute Hypoxemic Respiratory Failure and COVID-19: The RECOVERY-RS Randomized Clinical Trial**
- **Effect of Awake Prone Positioning on Endotracheal Intubation in Patients With COVID-19 and Acute Respiratory Failure: A Randomized Clinical Trial**
- **Beneficial Effects of Noninvasive Ventilation after Extubation in Obese or Overweight Patients: A *Post Hoc* Analysis of a Randomized Clinical Trial**
- **Intra-operative ventilator mechanical power as a predictor of postoperative pulmonary complications in surgical patients: A secondary analysis of a randomized clinical trial**
- **A novel machine learning model to predict respiratory failure and invasive mechanical ventilation in critically ill patients suffering from COVID-19**
- **Early Active Mobilization during Mechanical Ventilation in the ICU**

Alveolar mechanics: A new concept in respiratory monitoring

Cite: Daoud EG, Franck CL. Alveolar mechanics: A New Concept in Respiratory Monitoring. J Mech Vent 2022; 3(4):178-.188. DOI: https://doi.org/10.53097/JMV.10065

Abstract

A detailed understanding of respiratory mechanics during mechanical ventilation aids diagnostic accuracy and facilitates close monitoring of patient progress, allowing individualized ventilator adjustments aimed at minimizing ventilator induced lung injury. Respiratory mechanics can be described in terms of total respiratory, lung, and chest wall components and include compliance, resistance and are dependent on tidal volume, airway pressures, and flow for calculation. The interplay between the respiratory mechanics and ventilator delivered volume, flow, and pressure have an important role in the development of ventilator induced lung injury.
The knowledge of alveolar dynamics and mechanics in the critically ill are lacking with much information originating mainly from bench and animal models of healthy and injured lungs. In this article we introduce the concept of alveolar compliance, resistance that depend on measuring the trans-alveolar pressure using esophageal balloon manometry and alveolar tidal volume using volumetric capnometry. This may have multiple implications in the understanding of components of ventilator induced lung injury specifically alveolar stress, strain, and mechanical power. Further studies are warranted to further understanding the monitoring and usefulness of alveolar mechanics.

Comments

This is a concept interesting article. The authors describe how to measure alveolar compliance and resistance using esophageal balloon manometry to measure the trans-alveolar pressures and volumetric capnometry to compartmentalize the tidal volume into anatomical dead space and alveolar tidal volume.
They also review the potential implications for understanding and using alveolar mechanics in the field of Ventilator Induced Lung Injury.

The article is a nice physiology review of respiratory mechanics.

Oxygen-Saturation Targets for Critically Ill Adults Receiving Mechanical Ventilation

Semler MW, Casey JD, Lloyd BD, et al. PILOT Investigators and the Pragmatic Critical Care Research Group. Oxygen-Saturation Targets for Critically Ill Adults Receiving Mechanical Ventilation. N Engl J Med. 2022 Nov 10;387(19):1759-1769. Doi: 10.1056/NEJMoa2208415. Epub 2022 Oct 24. PMID: 36278971; PMCID: PMC9724830.

Abstract

Background: Invasive mechanical ventilation in critically ill adults involves adjusting the fraction of inspired oxygen to maintain arterial oxygen saturation. The oxygen-saturation target that will optimize clinical outcomes in this patient population remains unknown.
Methods: In a pragmatic, cluster-randomized, cluster-crossover trial conducted in the emergency department and medical intensive care unit at an academic center, we assigned adults who were receiving mechanical ventilation to a lower target for oxygen saturation as measured by pulse oximetry (Spo₂) (90%; goal range, 88 to 92%), an intermediate target (94%; goal range, 92 to 96%), or a higher target (98%; goal range, 96 to 100%). The primary outcome was the number of days alive and free of mechanical ventilation (ventilator-free days) through day 28. The secondary outcome was death by day 28, with data censored at hospital discharge.
Results: A total of 2541 patients were included in the primary analysis. The median number of ventilator-free days was 20 (interquartile range, 0 to 25) in the lower-target group, 21 (interquartile range, 0 to 25) in the intermediate-target group, and 21 (interquartile range, 0 to 26) in the higher-target group (P = 0.81). In-hospital death by day 28 occurred in 281 of the 808 patients (34.8%) in the lower-target group, 292 of the 859 patients (34.0%) in the intermediate-target group, and 290 of the 874 patients (33.2%) in the higher-target group. The incidences of cardiac arrest, arrhythmia, myocardial infarction, stroke, and pneumothorax were similar in the three groups.
Conclusions: Among critically ill adults receiving invasive mechanical ventilation, the number of ventilator-free days did not differ among groups in which a lower, intermediate, or higher Spo_2 target was used.

Comments

There has been multiple recent research on the hazards of hyperoxia on outcomes of mechanically ventilated patients. This current large one center study in ER-ICU patients divided patients into low target SPO2 (88-92), Intermediate (92-96), and high (96-100).
The results negative with no difference in ventilator free days or effects on 28 days mortality.
Limitations: only Spo2 measured, no PaO2/Fio2, or other ventilator parameters.
More studies are needed to define hyperoxia and targets of oxygenation.

Spontaneous-Breathing Trials with Pressure-Support Ventilation or a T-Piece

Thille AW, Gacouin A, Coudroy R, et al. REVA Research Network. Spontaneous-Breathing Trials with Pressure-Support Ventilation or a T-Piece. N Engl J Med. 2022 Nov 17;387(20):1843-1854. Doi: 10.1056/NEJMoa2209041. Epub 2022 Oct 26. PMID: 36286317.

Abstract

Background: Spontaneous-breathing trials can be performed with the use of either pressure-support ventilation (PSV) or a T-piece. Whether PSV trials may result in a shorter time to tracheal extubation than T-piece trials, without resulting in a higher risk of reintubation, among patients who have a high risk of extubation failure is unknown.
Methods: In this multicenter, open-label trial, we randomly assigned patients who had a high risk of extubation failure (> 65 years of age or had an underlying chronic cardiac or respiratory disease) to undergo spontaneous-breathing trials performed with the use of either PSV (with a pressure-support level of 8 cm of water and no positive end-expiratory pressure) or a T-piece. The primary outcome was the total time without exposure to invasive ventilation (reported as the number of ventilator-free days) at day 28 after the initial spontaneous-breathing trial. Secondary outcomes included extubation within 24 hours and extubation within 7 days after the initial spontaneous-breathing trial, as well as reintubation within 7 days after extubation.
Results: A total of 969 patients (484 in the PSV group and 485 in the T-piece group) were included in the analysis. At day 28, the median number of ventilator-free days was 27 (interquartile range, 24 to 27) in the PSV group and 27 (interquartile range, 23 to 27) in the T-piece group (difference, 0 days; 95% confidence interval [CI], -0.5 to 1; P = 0.31). Extubation was performed within 24 hours in 376 patients (77.7%) in the PSV group and in 350 patients (72.2%) in the T-piece group (difference, 5.5 percentage points; 95% CI, 0.01 to 10.9), and extubation was performed within 7 days in 473 patients (97.7%) and 458 patients (94.4%), respectively (difference, 3.3 percentage points; 95% CI, 0.8 to 5.9). Reintubation was performed in 72 of 481 patients (14.9%) in the PSV group and in 65 of 477 patients (13.6%) in the T-piece group (difference, 1.3 percentage points; 95% CI, -3.1 to 5.8). Cardiac or respiratory arrest was a reason for reintubation in 9 patients (3 in the PSV group and 6 in the T-piece group).
Conclusions: Among patients who had a high risk of extubation failure, spontaneous-breathing trials performed with PSV did not result in significantly more ventilator-free days at day 28 than spontaneous-breathing trials performed with a T-piece.

Comments

Recent studies have suggested that PSV might be superior in outcomes to T-piece for the SBT trials and extubation.
This study was large multicenter trial that included patients who are at high risk of extubation failure (older age, respiratory and cardiac diseases).
The results showed no significant differences between number of free days, success of extubation, re-intubation rates, or risks between both groups of PSV and T-piece.
Interestingly, almost 80% of patients who were extubated in both groups were extubated directly to NIV.
Additionally, this study shows that the re-intubation rate or failed extubation remains high at 13-15%.

Effect of Minimally Invasive Surfactant Therapy vs Sham Treatment on Death or Bronchopulmonary Dysplasia in Preterm Infants With Respiratory Distress Syndrome: The OPTIMIST-A Randomized Clinical Trial

Dargaville PA, Kamlin COF, Orsini F, et al. OPTIMIST-A Trial Investigators. Effect of Minimally Invasive Surfactant Therapy vs Sham Treatment on Death or Bronchopulmonary Dysplasia in Preterm Infants With Respiratory Distress Syndrome: The OPTIMIST-A Randomized Clinical Trial. JAMA. 2021 Dec 28;326(24):2478-2487. doi: 10.1001/jama.2021.21892. PMID: 34902013; PMCID: PMC8715350.

Abstract

Importance: The benefits of surfactant administration via a thin catheter (minimally invasive surfactant therapy [MIST]) in preterm infants with respiratory distress syndrome are uncertain.

Objective: To examine the effect of selective application of MIST at a low fraction of inspired oxygen threshold on survival without bronchopulmonary dysplasia (BPD).

Design, setting, and participants: Randomized clinical trial including 485 preterm infants with a gestational age of 25 to 28 weeks who were supported with continuous positive airway pressure (CPAP) and required a fraction of inspired oxygen of 0.30 or greater within 6 hours of birth. The trial was conducted at 33 tertiary-level neonatal intensive care units around the world, with blinding of the clinicians and outcome assessors. Enrollment took place between December 16, 2011, and March 26, 2020; follow-up was completed on December 2, 2020.

Interventions: Infants were randomized to the MIST group (n = 241) and received exogenous surfactant (200 mg/kg of poractant alfa) via a thin catheter or to the control group (n = 244) and received a sham (control) treatment; CPAP was continued thereafter in both groups unless specified intubation criteria were met.

Main outcomes and measures: The primary outcome was the composite of death or physiological BPD assessed at 36 weeks' postmenstrual age. The components of the primary outcome (death prior to 36 weeks' postmenstrual age and BPD at 36 weeks' postmenstrual age) also were considered separately.

Results: Among the 485 infants randomized (median gestational age, 27.3 weeks; 241 [49.7%] female), all completed follow-up. Death or BPD occurred in 105 infants (43.6%) in the MIST group and 121 (49.6%) in the control group (risk difference [RD], -6.3% [95% CI, -14.2% to 1.6%]; relative risk [RR], 0.87 [95% CI, 0.74 to 1.03]; P = .10). Incidence of death before 36 weeks' postmenstrual age did not differ significantly between groups (24 [10.0%] in MIST vs 19 [7.8%] in control; RD, 2.1% [95% CI, -3.6% to 7.8%]; RR, 1.27 [95% CI, 0.63 to 2.57]; P = .51), but incidence of BPD in survivors to 36 weeks' postmenstrual age was lower in the MIST group (81/217 [37.3%] vs 102/225 [45.3%] in the control group; RD, -7.8% [95% CI, -14.9% to -0.7%]; RR, 0.83 [95% CI, 0.70 to 0.98]; P = .03). Serious adverse events occurred in 10.3% of infants in the MIST group and 11.1% in the control group.

Conclusions and relevance: Among preterm infants with respiratory distress syndrome supported with CPAP, minimally invasive surfactant therapy compared with sham (control) treatment did not significantly reduce the incidence of the composite outcome of death or bronchopulmonary dysplasia at 36 weeks' postmenstrual age. However, given the statistical uncertainty reflected in the 95% CI, a clinically important effect cannot be excluded.

Comments

Surfactant therapy for premature infants with RDS has been recommended with previous studies showing improved outcomes in development of BPD.

This large multicenter-multinational trial compared surfactant treatment using catheter injected surfactant on neonates with RDS requiring CPAP therapy with FiO2 > 30% to control group.

There was no difference in terms of death or developing BPD at 36 weeks of gestation.

The role of surfactant in RDS might need to be revisited.

Effect of Noninvasive Respiratory Strategies on Intubation or Mortality Among Patients With Acute Hypoxemic Respiratory Failure and COVID-19: The RECOVERY-RS Randomized Clinical Trial

Perkins GD, Ji C, Connolly BA, et al. RECOVERY-RS Collaborators. Effect of Noninvasive Respiratory Strategies on Intubation or Mortality Among Patients With Acute Hypoxemic Respiratory Failure and COVID-19: The RECOVERY-RS Randomized Clinical Trial. JAMA. 2022 Feb 8;327(6):546-558. doi: 10.1001/jama.2022.0028. PMID: 35072713; PMCID: PMC8787685.

Abstract

Importance: Continuous positive airway pressure (CPAP) and high-flow nasal oxygen (HFNO) have been recommended for acute hypoxemic respiratory failure in patients with COVID-19. Uncertainty exists regarding the effectiveness and safety of these noninvasive respiratory strategies.

Objective: To determine whether either CPAP or HFNO, compared with conventional oxygen therapy, improves clinical outcomes in hospitalized patients with COVID-19-related acute hypoxemic respiratory failure.

Design, setting, and participants: A parallel group, adaptive, randomized clinical trial of 1273 hospitalized adults with COVID-19-related acute hypoxemic respiratory failure. The trial was conducted between April 6, 2020, and May 3, 2021, across 48 acute care hospitals in the UK and Jersey. Final follow-up occurred on June 20, 2021.

Interventions: Adult patients were randomized to receive CPAP (n = 380), HFNO (n = 418), or conventional oxygen therapy (n = 475).

Main outcomes and measures: The primary outcome was a composite of tracheal intubation or mortality within 30 days.

Results: The trial was stopped prematurely due to declining COVID-19 case numbers in the UK and the end of the funded recruitment period. Of the 1273 randomized patients (mean age, 57.4 [95% CI, 56.7 to 58.1] years; 66% male; 65% White race), primary outcome data were available for 1260. Crossover between interventions occurred in 17.1% of participants (15.3% in the CPAP group, 11.5% in the HFNO group, and 23.6% in the conventional oxygen therapy group). The requirement for tracheal intubation or mortality within 30 days was significantly lower with CPAP (36.3%; 137 of 377 participants) vs conventional oxygen therapy (44.4%; 158 of 356 participants) (absolute difference, -8% [95% CI, -15% to -1%], P = .03), but was not significantly different with HFNO (44.3%; 184 of 415 participants) vs conventional oxygen therapy (45.1%; 166 of 368 participants) (absolute difference, -1% [95% CI, -8% to 6%], P = .83). Adverse events occurred in 34.2% (130/380) of participants in the CPAP group, 20.6% (86/418) in the HFNO group, and 13.9% (66/475) in the conventional oxygen therapy group.

Conclusions and relevance: Among patients with acute hypoxemic respiratory failure due to COVID-19, an initial strategy of CPAP significantly reduced the risk of tracheal intubation or mortality compared with conventional oxygen therapy, but there was no significant difference between an initial strategy of HFNO compared with conventional oxygen therapy. The study may have been underpowered for the comparison of HFNO vs conventional oxygen therapy, and early study termination and crossover among the groups should be considered when interpreting the findings.

Comments

Conflicting reports regarding the role of NIV and HFNO on intubation and mortality compared to conventional oxygen therapy in COVID-19 patients. Some studies showed positive results of CPAP and HFNO.

This multicenter UK study showed reduced risks of intubation of patients using CPAP compared to conventional oxygen therapy but not mortality. HFNO did not show any difference in intubation or mortality.

Limitation: there was large cross over of subjects between all groups.

The answer remains controversial of whether NIV with CPAP or HFNO improves outcomes during COVID-19.

Effect of Awake Prone Positioning on Endotracheal Intubation in Patients With COVID-19 and Acute Respiratory Failure: A Randomized Clinical Trial

Alhazzani W, Parhar KKS, Weatherald J, et al. COVI-PRONE Trial Investigators and the Saudi Critical Care Trials Group. Effect of Awake Prone Positioning on Endotracheal Intubation in Patients With COVID-19 and Acute Respiratory Failure: A Randomized Clinical Trial. JAMA. 2022 Jun 7;327(21):2104-2113. doi: 10.1001/jama.2022.7993. PMID: 35569448; PMCID: PMC9108999.

Abstract

Importance: The efficacy and safety of prone positioning is unclear in nonintubated patients with acute hypoxemia and COVID-19.

Objective: To evaluate the efficacy and adverse events of prone positioning in nonintubated adult patients with acute hypoxemia and COVID-19.

Design, setting, and participants: Pragmatic, unblinded randomized clinical trial conducted at 21 hospitals in Canada, Kuwait, Saudi Arabia, and the US. Eligible adult patients with COVID-19 were not intubated and required oxygen (≥40%) or noninvasive ventilation. A total of 400 patients were enrolled between May 19, 2020, and May 18, 2021, and final follow-up was completed in July 2021.

Intervention: Patients were randomized to awake prone positioning (n = 205) or usual care without prone positioning (control; n = 195).

Main outcomes and measures: The primary outcome was endotracheal intubation within 30 days of randomization. The secondary outcomes included mortality at 60 days, days free from invasive mechanical ventilation or noninvasive ventilation at 30 days, days free from the intensive care unit or hospital at 60 days, adverse events, and serious adverse events.

Results: Among the 400 patients who were randomized (mean age, 57.6 years [SD, 12.83 years]; 117 [29.3%] were women), all (100%) completed the trial. In the first 4 days after randomization, the median duration of prone positioning was 4.8 h/d (IQR, 1.8 to 8.0 h/d) in the awake prone positioning group vs 0 h/d (IQR, 0 to 0 h/d) in the control group. By day 30, 70 of 205 patients (34.1%) in the prone positioning group were intubated vs 79 of 195 patients (40.5%) in the control group (hazard ratio, 0.81 [95% CI, 0.59 to 1.12], P = .20; absolute difference, -6.37% [95% CI, -15.83% to 3.10%]). Prone positioning did not significantly reduce mortality at 60 days (hazard ratio, 0.93 [95% CI, 0.62 to 1.40], P = .54; absolute difference, -1.15% [95% CI, -9.40% to 7.10%]) and had no significant effect on days free from invasive mechanical ventilation or noninvasive ventilation at 30 days or on days free from the intensive care unit or hospital at 60 days. There were no serious adverse events in either group. In the awake prone positioning group, 21 patients (10%) experienced adverse events and the most frequently reported were musculoskeletal pain or discomfort from prone positioning (13 of 205 patients [6.34%]) and desaturation (2 of 205 patients [0.98%]). There were no reported adverse events in the control group.

Conclusions and relevance: In patients with acute hypoxemic respiratory failure from COVID-19, prone positioning, compared with usual care without prone positioning, did not significantly reduce endotracheal intubation at 30 days. However, the effect size for the primary study outcome was imprecise and does not exclude a clinically important benefit.

Comments

Awake prone position during COVID-19 initially shown promising benefits and was incorporated on daily practice and societies guidelines.

However recent trials challenged those findings.

This multicenter trial compared awake proning for 4.8 hrs/day to no proning on endotracheal intubation, mortality or 30 days ventilation free or 60 days hospital or ICU days. More side effects though non serious was reported in the prone group.

Limitations: the duration of awake proning remains unknown, but 5 hours might still be too short to confer benefits, but longer timing might be difficult for non-intubated, sedated patients.

Beneficial Effects of Noninvasive Ventilation after Extubation in Obese or Overweight Patients: A *Post Hoc* Analysis of a Randomized Clinical Trial

Thille AW, Coudroy R, Nay MA, et al. HIGH-WEAN Study Group and the REVA Research Network. Beneficial Effects of Noninvasive Ventilation after Extubation in Obese or Overweight Patients: A *Post Hoc* Analysis of a Randomized Clinical Trial. Am J Respir Crit Care Med. 2022 Feb 15;205(4):440-449. doi: 10.1164/rccm.202106-1452OC. PMID: 34813391.

Abstract

Rationale: Although noninvasive ventilation (NIV) may prevent reintubation in patients at high risk of extubation failure in ICUs, this oxygenation strategy has not been specifically assessed in obese patients.
Objectives: We hypothesized that NIV may decrease the risk of reintubation in obese patients compared with high-flow nasal oxygen.
Methods: *Post hoc* analysis of a multicenter randomized controlled trial (not prespecified) comparing NIV alternating with high-flow nasal oxygen versus high-flow nasal oxygen alone after extubation, with the aim of assessing NIV effects according to patient body mass index (BMI).
Measurements and Main Results: Among 623 patients at high risk of extubation failure, 206 (33%) were obese (BMI $\geqslant$ 30 kg/m^2), 204 (33%) were overweight (25 kg/m^2 $\leqslant$ BMI < 30 kg/m^2), and 213 (34%) were normal or underweight (BMI < 25 kg/m^2). Significant heterogeneity of NIV effects on the rate of reintubation was found according to BMI ($P_{interaction}$ = 0.007). Reintubation rates at Day 7 were significantly lower with NIV alternating with high-flow nasal oxygen than with high-flow nasal oxygen alone in obese or overweight patients: 7% (15/204) versus 20% (41/206) (difference, -13% [95% confidence interval, -19 to -6]; P = 0.0002), whereas it did not significantly differ in normal or underweight patients. In-ICU mortality was significantly lower with NIV than with high-flow nasal oxygen alone in obese or overweight patients (2% vs. 9%; difference, -6% [95% confidence interval, -11 to -2]; P = 0.006).
Conclusions: Prophylactic NIV alternating with high-flow nasal oxygen immediately after extubation significantly decreased the risk of reintubation and death compared with high-flow nasal oxygen alone in obese or overweight patients at high risk of extubation failure. By contrast, NIV was not effective in normal or underweight patients.

Comments

Obesity poses high risk of extubation failure and re-intubation. Older studies have showed that application of NIV might worsen outcomes. However newer studies challenged those findings and post extubation NIV have shown to improve outcomes especially in COPD and other high-risk patients.
This post-hoc analysis of large multicenter trial shows that prophylactic extubation to NIV alternating with HFNO was more superior in terms of re-intubation and mortality than HFNO alone in overweight and obese patients but not in normal weight patients.

Intra-operative ventilator mechanical power as a predictor of postoperative pulmonary complications in surgical patients: A secondary analysis of a randomised clinical trial

Karalapillai D, Weinberg L, Neto A S, et al. Intra-operative ventilator mechanical power as a predictor of postoperative pulmonary complications in surgical patients: A secondary analysis of a randomised clinical trial. Eur J Anaesthesiol. 2022 Jan 1;39(1):67-74. doi: 10.1097/EJA.0000000000001601. PMID: 34560687; PMCID: PMC8654268.

Abstract

Background: Studies in critically ill patients suggest a relationship between mechanical power (an index of the energy delivered by the ventilator, which includes driving pressure, respiratory rate, tidal volume and inspiratory pressure) and complications.

Objective: We aimed to assess the association between intra-operative mechanical power and postoperative pulmonary complications (PPCs).

Design: Post hoc analysis of a large randomised clinical trial.

Setting: University-affiliated academic tertiary hospital in Melbourne, Australia, from February 2015 to February 2019.

Patients: Adult patients undergoing major noncardiothoracic, nonintracranial surgery.

Intervention: Dynamic mechanical power was calculated using the power equation adjusted by the respiratory system compliance (CRS). Multivariable models were used to assess the independent association between mechanical power and outcomes.

Main outcome measures: The primary outcome was the incidence of PPCs within the first seven postoperative days. The secondary outcome was the incidence of acute respiratory failure.

Results: We studied 1156 patients (median age [IQR]: 64 [55 to 72] years, 59.5% men). Median mechanical power adjusted by CRS was 0.32 [0.22 to 0.51] (J min-1)/(ml cmH2O-1). A higher mechanical power was also independently associated with increased risk of PPCs [odds ratio (OR 1.34, 95% CI, 1.17 to 1.52); P < 0.001) and acute respiratory failure (OR 1.40, 95% CI, 1.21 to 1.61; P < 0.001).

Conclusion: In patients receiving ventilation during major noncardiothoracic, nonintracranial surgery, exposure to a higher mechanical power was independently associated with an increased risk of PPCs and acute respiratory failure.

Comments

Mechanical power during mechanical ventilation have been related to VILI and mortality. This large single study examined the effect of intra-operative mechanical power on post operative complications and acute post operative respiratory failure within 7 days.

The study adds more evidence to the clinical usefulness of mechanical power to guide mechanical ventilation even for short duration of time.

Limitations: the study is a post hoc analysis, no plateau or DP numbers were collected.

A novel machine learning model to predict respiratory failure and invasive mechanical ventilation in critically ill patients suffering from COVID-19

Bendavid I, Statlender L, Shvartser L, et al. A novel machine learning model to predict respiratory failure and invasive mechanical ventilation in critically ill patients suffering from COVID-19. Sci Rep 12, 10573 (2022). https://doi.org/10.1038/s41598-022-14758-x

Abstract

In hypoxemic patients at risk for developing respiratory failure, the decision to initiate invasive mechanical ventilation (IMV) may be extremely difficult, even more so among patients suffering from COVID-19. Delayed recognition of respiratory failure may translate into poor outcomes, emphasizing the need for stronger predictive models for IMV necessity.

We developed a two-step model; the first step was to train a machine learning predictive model on a large dataset of non-COVID-19 critically ill hypoxemic patients from the United States (MIMIC-III). The second step was to apply transfer learning and adapt the model to a smaller COVID-19 cohort. An XGBoost algorithm was trained on data from the MIMIC-III database to predict if a patient would require IMV within the next 6, 12, 18 or 24 h. Patients' datasets were used to construct the model as time series of dynamic measurements and laboratory results obtained during the previous 6 h with additional static variables, applying a sliding time-window once every hour. We validated the adaptation algorithm on a cohort of 1061 COVID-19 patients from a single center in Israel, of whom 160 later deteriorated and required IMV.

The new XGBoost model for the prediction of the IMV onset was trained and tested on MIMIC-III data and proved to be predictive, with an AUC of 0.83 on a shortened set of features, excluding the clinician's settings, and an AUC of 0.91 when the clinician settings were included. Applying these models "as is" (no adaptation applied) on the dataset of COVID-19 patients degraded the prediction results to AUCs of 0.78 and 0.80, without and with the clinician's settings, respectively. Applying the adaptation on the COVID-19 dataset increased the prediction power to an AUC of 0.94 and 0.97, respectively. Good AUC results get worse with low overall precision. We show that precision of the prediction increased as prediction probability was higher. Our model was successfully trained on a specific dataset, and after adaptation it showed promise in predicting outcome on a completely different dataset. This two-step model successfully predicted the need for invasive mechanical ventilation 6, 12, 18 or 24 h in advance in both general ICU population and COVID-19 patients. Using the prediction probability as an indicator of the precision carries the potential to aid the decision-making process in patients with hypoxemic respiratory failure despite the low overall precision.

Comments

A very interesting study about the use of Artificial Intelligence AI and machine learning algorithm, to predict the need for mechanical ventilation in cohort of COVID-19 patients. The algorithm had a very good prediction in the first 24 hours that was improved when clinicians settings were included.

Given the high mortality of respiratory failure in general, delayed intubation might worsen outcomes and the need for assistance in decision making to start mechanical ventilation might be useful.

More studies will be coming in different decision-making using AI in the field of mechanical ventilation.

Early Active Mobilization during Mechanical Ventilation in the ICU

TEAM Study Investigators and the ANZICS Clinical Trials Group, Hodgson CL, Bailey M, Bellomo R, et al. Early Active Mobilization during Mechanical Ventilation in the ICU. N Engl J Med. 2022 Nov 10;387(19):1747-1758. doi: 10.1056/NEJMoa2209083. Epub 2022 Oct 26. PMID: 36286256.

Abstract

Background: Intensive care unit (ICU)-acquired weakness often develops in patients who are undergoing invasive mechanical ventilation. Early active mobilization may mitigate ICU-acquired weakness, increase survival, and reduce disability.

Methods: We randomly assigned 750 adult patients in the ICU who were undergoing invasive mechanical ventilation to receive increased early mobilization (sedation minimization and daily physiotherapy) or usual care (the level of mobilization that was normally provided in each ICU). The primary outcome was the number of days that the patients were alive and out of the hospital at 180 days after randomization.

Results: The median number of days that patients were alive and out of the hospital was 143 (interquartile range, 21 to 161) in the early-mobilization group and 145 days (interquartile range, 51 to 164) in the usual-care group (absolute difference, -2.0 days; 95% confidence interval [CI], -10 to 6; P = 0.62). The mean (±SD) daily duration of active mobilization was 20.8±14.6 minutes and 8.8±9.0 minutes in the two groups, respectively (difference, 12.0 minutes per day; 95% CI, 10.4 to 13.6). A total of 77% of the patients in both groups were able to stand by a median interval of 3 days and 5 days, respectively (difference, -2 days; 95% CI, -3.4 to -0.6). By day 180, death had occurred in 22.5% of the patients in the early-mobilization group and in 19.5% of those in the usual-care group (odds ratio, 1.15; 95% CI, 0.81 to 1.65). Among survivors, quality of life, activities of daily living, disability, cognitive function, and psychological function were similar in the two groups. Serious adverse events were reported in 7 patients in the early-mobilization group and in 1 patient in the usual-care group. Adverse events that were potentially due to mobilization (arrhythmias, altered blood pressure, and desaturation) were reported in 34 of 371 patients (9.2%) in the early-mobilization group and in 15 of 370 patients (4.1%) in the usual-care group (P = 0.005).

Conclusions: Among adults undergoing mechanical ventilation in the ICU, an increase in early active mobilization did not result in a significantly greater number of days that patients were alive and out of the hospital than did the usual level of mobilization in the ICU. The intervention was associated with increased adverse events.

Comments

Recent studies showed that early mobilization might be beneficial in reducing ventilator days and mortality. This large study did not show any significance between usual care (patients were getting physiotherapy) vs increased early mobilization in terms of daus alive and out of the hospital.

Risks were higher in the early mobilization group.

Timing and duration of physiotherapy and mobilization are yet to be determined