Outcomes in the Use of NIV in Asthma Exacerbation vs Standard Treatment

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1. Introduction

    a. Asthma is the most common chronic illness of childhood. Although first line treatments are commonly practiced, the use of non-invasive positive pressure ventilation is less well-studied. Asthma is the most common chronic illness of childhood. The rate of hospital admissions caused by asthma among children is approximately 5%; episodes of respiratory failure are uncommon in this population, being developed in 8 to 24% of the asthmatic children admitted to pediatric intensive care units. Observational studies have reported that 10% to 12% of children admitted to the pediatric intensive care unit (PICU) with asthma required invasive ventilation Noninvasive ventilation (NIV) was first used in adults by the end of the 1980s. At our institution NIV is commonly used for status asthmaticus in addition to continuous albuterol, but there is no standardized protocol on when to escalate therapy.
    b. Status Asthmatics is characterized by diffuse lower airway obstruction inflammation/edema, bronchial smooth muscle spasm and mucus plugging. The expiratory phase of breathing becomes prolonged in an attempt to overcome airway resistance. Lungs become overdistended, increasing intrinsic PEEP. NIV may help asthma exacerbations through alveolar recruitment. The airflow increases through collateral ventilation channels, resulting in re-expansion of areas with atelectasis and

improvement of the ventilation/perfusion ratio, with a consequent reduction in the work of breathing. When applied in bilevel positive airway pressure (BIPAP) mode, the inspiratory positive airway pressure (IPAP) might help the inspiratory muscles to overcome the limitation to the airflow and chest overdistension, thus increasing the tidal volume.(

2. Hypothesis
    a. Our hypothesis is that outcomes differ in asthmatics treated with non-invasive therapy vs standard continuous bronchodilators.
3. Methods
    a. I am measuring duration on continuous albuterol in hours in patients who received non-invasive ventilation vs those who did not. I am also comparing length of stay in the PICU.
    b. This is a retrospective chart review of patients admitted to the PICU for status asthmatics during 2018.
4. Statistical Analysis/Data Selection
    a. I will use an unpaired T-test to compare the average time on continuous albuterol between patients on NIV vs. no ventilatory assistance. This analysis will be repeated on the primary outcome of PICU length of stay.
    b. Confounding variables to be considered in analysis include: blood gas, RVP, CXR, age, weight , gender, comorbities, asthma severity, magnesium, terbutaline, steroid therapy

c. Data from 2009 to 2018 are available including moderate to severe asthmatics admitted to PICU for exacerbation. There are approximately 40 subjects per year, but some will need to be excluded.

d. The following are inclusion criteria: admission for status asthmaticus to the PICU, on continuous albuterol.

e. The following are xxclusion Criteria: intubation, tracheostomy, recent discharge from PICU for exacerbation

5. Miscellaneous:

   a. Study Procedure: Data will be obtained and analyzed as described above.

   b. Study Drugs: None

   c. Medical Device: None

   d. Study Questionnaires: None

   e. Study Subjects: Moderate to severe asthmatics admitted to PICU from 2009-2018

   f. Recruitment of subjects: Subjects will be recruited from retrospective chart review. This study will apply for waiver of consent.

   g. Confidentiality of Study Data:

      i. Chart review will be done only on secure, password protected computers. All patient identifiers will be removed from the electronic data set prior to analysis, and each patient will be assigned a unique study ID number. Only the study personnel will have access to the file, which will be kept on encrypted endpoint devices.

h. Potential Conflict of Interest: None

i. Location of the Study: Columbia/CUMC-PICU

j. Potential Risks: Not applicable

k. Potential Benefits: There will be no direct benefit to the participant.

l. Alternative Therapies: Not Applicable

m. Compensation to Subjects: None

n. Costs to Subjects: Not Applicable

o. Minors as Research Subjects: Not Applicable

p. Radiation or Radioactive Substances: Not Applicable

References

- Basnet S, Mander G, Andoh J, Klaska H, Verhulst S, Koirala J. Safety, efficacy, and tolerability of early initiation of noninvasive positive pressure ventilation in pediatric patients admitted with status asthmaticus: a pilot study. Pediatric Critical Care Medicine 2012;13(4):393- 8. [CENTRAL: 834472; CRS: 4900100000062937; EMBASE: 2012437313] [PubMed] [Google Scholar]
- Thill PJ, McGuire JK, Baden HP, Green TP, Checchia PA. Noninvasive positive-pressure ventilation in children with lower airway obstruction. Pediatric Critical Care Medicine 2004;5(4):337- 42. [CENTRAL: 489916; CRS: 4900100000017175; PUBMED: 15215002] [PubMed] [Google Scholar]
- Marohn K, Panisello JM. Noninvasive ventilation in pediatric intensive care. Curr Opin Pediatr. 2013;25(3):290–296. [PubMed] [Google Scholar]
- Argent AC, Biban P. What's new on NIV in the PICU: does everyone in respiratory failure require endotracheal intubation? Intensive Care Med. 2014;40(6):880–884.[PubMed] [Google Scholar]
- Papiris S, Kotanidou A, Malagari K, Roussos C. Clinical review: severe asthma. Crit Care. 2002;6(1):30–44. [PMC free article] [PubMed] [Google Scholar]
- Mayordomo-Colunga J, Medina A, Rey C, Concha A, Menéndez S, Arcos ML, et al. Non-invasive ventilation in pediatric status asthmaticus: a prospective observational study. Pediatr Pulmonol. 2011;46(10):949–955. [PubMed] [Google Scholar]
- Diretrizes da Sociedade Brasileira de Pneumologia e Tisiologia para o Manejo da Asma - 2012. J Bras de Pneumol. 2012;38(Supl 1):S1–46. [PubMed] [Google Scholar]
- Schettino GP, Reis MA, Galas F, Park M, Franca S, Okamoto V. Mechanical ventilation noninvasive with positive pressure . J Bras Pneumol. 2007;33(Suppl 2S):S92–105.Portuguese. [PubMed] [Google Scholar]

- Carson KV, Usmani ZA, Smith BJ. Noninvasive ventilation in acute severe asthma: current evidence and future perspectives. Curr Opin Pulm Med. 2014;20(1):118–123.[PubMed] [Google Scholar]
- Pons Odena M, Cambra Lasaosa FJ, Sociedad Española de Cuidados Intensivos PediátricosMechanical ventilation in pediatrics (III). Weaning, complications and other types of ventilation. Noninvasive ventilation]. An Pediatr (Barc) 2003;59(2):165–172.Spanish. [PubMed] [Google Scholar]
- James MM, Beilman GJ. Mechanical ventilation. Surg Clin North Am. 2012;92(6):1463–1474. [PubMed] [Google Scholar]
- Carroll CL, Schramm CM. Noninvasive positive pressure ventilation for the treatment of status asthmaticus in children. Ann Allergy Asthma Immunol. 2006;96(3):454–459.[PubMed] [Google Scholar]
- Guyatt GH, Oxman AD, Kunz R, Falck-Ytter Y, Vist GE, Liberati A, Schünemann HJ, GRADE Working Group Going from evidence to recommendations. BMJ. 2008;336(7652):1049–1051. [PMC free article] [PubMed] [Google Scholar]
- Guyatt GH, Oxman AD, Kunz R, Jaeschke R, Helfand M, Liberati A, Vist GE, Schünemann HJ, GRADE Working Group Incorporating considerations of resources use into grading recommendations. BMJ. 2008;336(7654):1170–1173. [PMC free article][PubMed] [Google Scholar]
- Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, Schünemann HJ, GRADE Working Group GRADE Wan emerging consensus on rating quality of evidence and strength of recommendations. BMJ. 2008;336(7650):924–926.[PMC free article] [PubMed] [Google Scholar]
- Atkins D, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S, Guyatt GH, Harbour RT, Haugh MC, Henry D, Hill S, Jaeschke R, Leng G, Liberati A, Magrini N, Mason J, Middleton P, Mrukowicz J, O'Connell D, Oxman AD, Phillips B, Schünemann HJ, Edejer T, Varonen H, Vist GE, Williams JW, Jr, Zaza S, GRADE Working Group Grading quality of evidence and strength of recommendations. BMJ. 2004;328(7454):1490–1490.[PMC free article] [PubMed] [Google Scholar]
- Guyatt GH, Oxman AD, Kunz R, Vist GE, Falck-Ytter Y, Schünemann HJ, GRADE Working Group What is "quality of evidence" and why is it important to clinicians. BMJ. 2008;336(7651):995–998. [PMC free article] [PubMed] [Google Scholar]
- Guyatt GH, Norris SL, Schulman S, Hirsh J, Eckman MH, Akl EA, Crowther M, Vandvik PO, Eikelboom JW, McDonagh MS, Lewis SZ, Gutterman DD, Cook DJ, Schünemann HJ, American College of Chest Physicians Methodology for the development of antithrombotic therapy and prevention of thrombosis guidelines: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest. 2012;141(2) Suppl:53S–70S. [PMC free article] [PubMed] [Google Scholar]
- Basnet S, Mander G, Andoh J, Klaska H, Verhulst S, Koirala J. Safety, efficacy, and tolerability of early initiation of noninvasive positive pressure ventilation in pediatric patients admitted with status asthmaticus: a pilot study. Pediatr Crit Care Med. 2012;13(4):393–398. [PubMed] [Google Scholar