Non-invasive Ventilation Versus Conventional Oxygen Therapy in Immunocompromised Patients: A Meta-analysis

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Abstract

Introduction: Respiratory failure is common in immunocompromised patients. Intubation and mechanical ventilation (MV) is the mainstay of treatment but is associated with increased risk of pneumonia and other complications. Non-invasive ventilation (NIV) is an alternative to MV in a select group of patients and aims to avoid the complications of MV. In these patients, we performed a meta-analysis on the effect of NIV versus conventional oxygen therapy in reducing intubation rates and other important clinical outcomes.

Methods: We performed an extensive online and unpublished data search for relevant studies that met the inclusion criteria. Randomized controlled trials that used NIV versus conventional oxygen therapy in immunocompromised patients with respiratory failure were included in the meta-analysis. Eligbility and risk of bias assessments were performed independently by three authors. The primary outcome of interest was intubation and mechanical ventilation rate. The secondary outcomes were intensive care unit (ICU) and all-cause mortality, ICU length of stay and duration of mechanical ventilation.

Results: Out of the twenty initially screened studies, four studies with a total of 553 patients met the criteria for inclusion and were included in the analysis. Patients given NIV were 38% less likely to be intubated vs. those given oxygen, RR 0.62 (95%CI 0.42,0.93); however, this analysis result is significantly heterogenous. After sensitivity analysis, results showed 48% less likelihood of intubation and mechanical ventilation in the group treated with NIV, RR 0.52 (95% confidence interval (CI) 0.35,0.77). Patients on NIV had 1.18 days less stay in the ICU vs. oxygen group (95%CI -1.84,-0.52 days).

Three studies included ICU mortality in their outcomes and showed a 54% decrease in ICU mortality among patients given NIV, RR 0.46 (95% CI 0.17, 1.29), however this result is non-significant and heterogenous I^2=58%. There was no statistically significant decrease in all-cause mortality between the two groups, RR 0.77 (95% CI 0.53,1.11). After a sensitivity analysis performed specifically for this outcome, results showed a 32% reduction in all cause mortality in patients given NIV vs. oxygen therapy, however was not statistically significant RR 0.68 (95% CI 0.53-1.11) and was heterogenous I^2=50%. There is no difference in the duration of mechanical ventilation between groups.

Conclusion: In immunocompromised patients with respiratory failure, NIV reduced intubation rates, and length of ICU stay, compared to standard oxygen therapy. This intervention also showed trend toward ICU and all-cause mortality reduction.

Keywords: non-invasive ventilation, conventional oxygen therapy

Introduction

Immunocompromised patients are a special group of patients due to their high propensity to develop infectious complications.[1] These patients include those with underlying solid organ/hematologic malignancies, those on chronic steroids and other immunosuppressive drugs for various conditions, patients with human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS), neutropenia, uncontrolled diabetes, and other underlying conditions that have an effect on suppressing any component of the immune system.[2] Oftentimes, these patients are admitted to the hospital for infectious diseases, and are at an increased risk for developing in-patient infectious complications such as hospital-acquired pneumonia and diarrhea.[1,2,5] These patients frequently require more intensive monitoring and aggressive treatment because mortality and morbidity rates are high.[3]

The lungs are the most common site of infection in immunocompromised patients,[2,3] and some of the commonly afflicting organisms are unusual microorganisms that rarely affect immunocompetent individuals. These infections are also often severe enough to cause respiratory failure and warrant intensive care unit (ICU) admission and mechanical ventilation.

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Invasive mechanical ventilation through endotracheal or nasotracheal ventilation is often employed in critically ill patients with respiratory failure to augment the increased oxygen demands. The usual indications for invasive ventilation are severe pneumonia, aspiration, chronic obstructive pulmonary disease (COPD) exacerbations, acute respiratory distress syndrome (ARDS), etc. Although life-saving, it is especially associated with a high complication and morbidity rates, with ventilator-associated pneumonia being one of the most common complications noted. This is indeed very worrisome for immunocompromised patients since they have higher propensity to develop infectious complications associated with invasive mechanical ventilation.

Non-invasive ventilation (NIV) using a tight-fitting face mask and employed through Bi-level positive airway pressure ventilation (BIPAP) or continuous positive airway pressure ventilation (CPAP) is subtype of mechanical ventilation that was developed to avoid the serious morbidity and mortality rates associated with invasive mechanical ventilation. It is associated with lower infection rates, lower rates of airway injuries and allows earlier return to normal level of activity and earlier hospital discharge. It is widely employed in a variety of patients in respiratory failure; unfortunately, this mechanical ventilation strategy is highly selective and is also associated with high failure rates if patient selection is not done properly. Some of the contraindications to non-invasive ventilation include severe respiratory distress, encephalopathy, facial trauma or burns, inability to effectively clear airway secretions and cardiopulmonary arrest—all of which, if present, are managed by invasive mechanical ventilation.

Non-invasive ventilation (NIV) is an alternative to invasive ventilation in highly select patients with respiratory failure and is also hypothesized to be effective as tide-over for patients with respiratory failure and thus avoid invasive ventilation. However, the only proven indication for NIV that showed convincing results are patients suffering from acute hypercapnia and respiratory acidosis in patients with respiratory failure from exacerbations of COPD.[1] Because it is safer and avoids the usual complications from invasive mechanical ventilation, it is imperative to explore other patient subgroups where NIV may have benefits. Immunocompromised patients with respiratory failure are one group wherein it is postulated that may benefit from NIV because of the great benefit of avoiding an invasive device, thus reducing the risk of potential infections. In one retrospective study by, first line NIV markedly improved survival by a 25% reduction in mortality among patients with acute respiratory failure. Two more studies, a prospective case-control trial[8] supported noninvasive positive-pressure ventilation (NPPV) use in acute respiratory failure (ARF) from pneumocystis jiroveci pneumonia (PCP) in patients with AIDS demonstrating 33% reduction in invasive mechanical ventilation (IMV) and better survival, and the other, a multicenter, prospective, randomized trial[14] showed significant reduction in intubation and length of ICU stay in NIV in patients with severe community-acquired pneumonia (CAP). Studies involving immunocompromised patients however are still lacking, and are also conflicting. One retrospective review[9] on patients with hematologic malignancies did not show a difference in the mortality rates between patients treated with NIV compared to those who were intubated. These conflicting evidences prompted studies on NIV in immunocompromised patients with more robust methodologies to be done.[1,2,3,4]

Therefore, NIV is purported to be of benefit in immunocompromised patients with respiratory failure since it may avoid invasive ventilation and the complications associated with it. It is important to ascertain the benefit of NIV in these subgroup of patients, because if proven beneficial, it will potentially decrease mortality and complication rates associated with invasive ventilation.

This review is aimed primarily to determine the efficacy of NIV versus conventional oxygen therapy in reducing intubation and mechanical ventilation rates among immunocompromised patients with respiratory failure. Secondary outcome measures are the efficacy of NIV versus conventional oxygen therapy in reducing ICU length of stay, ICU mortality rate, all-cause mortality and duration of mechanical ventilation.

Methods

We included randomized controlled trials (RCT) that employed non-invasive ventilation versus conventional therapy with oxygen via face mask in adult immunocompromised patients with acute respiratory failure in our meta-analysis. Studies that included immunocompromised patients aged 18 and above (from neutropenia, hematologic malignancy, post solid organ or bone marrow transplantation, solid organ malignancies, chronic steroid use or HIV infection/AIDS) with respiratory failure were included in the review. Acute respiratory failure (ARF) is defined as $PaO_2 < 60$ mmHg on room air, tachypnea >30/min, or labored breathing or respiratory distress or dyspnea at rest.

The intervention used in this study involved non-invasive ventilation employing various commercial ventilators versus conventional oxygenation via face mask or nasal cannula, adjusting flow rates to maintain O_2 Saturation > 90%. Studies excluded would be studies apart from randomized control trials, and those who did not meet the above criteria.

The primary outcome of interest in this review is intubation and mechanical ventilation rates between those treated with NIV versus those placed on conventional oxygen therapy. Other outcomes that were also measured were the ICU length of stay, ICU mortality rate, all-cause mortality, duration of mechanical ventilation, and length of hospital stay between the two groups.

A computerized search using the standard PUBMED free text search and MeSH terms "Non invasive ventilation", "immunocompromised host", "hematologic malignancy", "solid tumors", "solid organ transplant", "immunosuppresive drug use", "HIV" were using the following databases: PubMed, Medline, Embase and CENTRAL, Cochrane Database, and Google Scholar. Unpublished researches thru conference book of abstracts and pharmaceutical companies were also sought. Three authors independently assessed studies for inclusion into the meta-analysis. Uncertainties and discrepancies were settled by votation and consensus.

Results

Twenty studies were initially screened for inclusion, however 16 studies failed the inclusion because they were either case reports, or cohorts and did not meet the criteria for inclusion. Studies were included if it included at least one of our study outcomes in their analysis and not necessarily of the primary outcome alone (see Appendix A).

Four studies[10,11,12,13] met the eligibility criteria and were included in the final analysis with a total population of 553 patients (280 in the NIV group and 273 in the oxygen therapy group). All four studies were prospective, randomized trials that dealt with immunocompromised patients with respiratory failure. However, the reason for the immunocompromised states differ from study to study. Antonelli et al. performed this trial in patients who were immunosuppressed after solid organ transplantation, and Wermke et al had a population of patients who underwent allogeneic hematopoietic stem cell transplantation. Furthermore, Hilbert et al. and Lemiale et. al had a mix of immunodeficient patients enrolled in their trials (chemotherapy-induced neutropenia, AIDS, prolonged steroid use and hematologic malignancies). Despite this differences in the population subgroup, all studies were uniform in the definition of respiratory failure.

All four studies compared standard oxygenation methods (via cannula or face mask) versus NIV (via full face mask), using different commercial machines available. All the studies employed intermittent NIV or oxygen therapy adjusted to achieve adequate oxygen saturations. These studies also employed intubation and mechanical ventilation in patients who were not able to tolerate either conventional oxygen or NIV and were recorded in the study as an outcome; and all but one study had intubation and mechanical ventilation as the primary outcome (Table I and II).

Eligible Studies

1. Antonelli, et al. Noninvasive ventilation for treatment of acute respiratory failure in patients undergoing solid organ transplantation (2000)
2. Hilbert, et al. Noninvasive ventilation in immunosuppressed patients with pulmonary infiltrates, fever, and acute respiratory failure. (2001)
3. Wermke, et al. Respiratory failure in patients undergoing allogeneic hematopoietic SCT – a randomized trial on early non-invasive ventilation based on standard care hematology wards. (2011)
4. Lemiale et al. Effect of noninvasive ventilation vs oxygen therapy on mortality among immunocompromised patients with acute respiratory failure: A randomized clinical trial (2015)

Three authors extracted data independently from eligible studies using a standard data extraction form (Appendix B). The following outcomes will be evaluated: rates of intubation and mechanical ventilation as primary outcome; ICU mortality rate, ICU length of stay, all-cause mortality, duration of mechanical ventilation, incidence of infectious complications and total hospital length of stay as secondary outcomes.

The authors also assessed the risk of bias in terms of sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting independently. Discrepancies and issues were resolved by consensus. All parameters were low risk for each of the study except blinding which is attributed to the nature of the intervention. (Table III)

Study Outcomes

Intubation and Mechanical Ventilation Rates

All included studies had failure of oxygenation or NIV included in their outcomes. Analysis showed that patients who were given NIV had a significant 38% reduction in intubation compared to those given conventional oxygen therapy, relative risk (RR) 0.62 (95% (confidence interval (CI) 0.42, 0.93). This outcome was significantly heterogenous, I^2=54% (Figure 1).

We performed a sensitivity analysis and excluded the study by Lemiale due to a heterogenous population, and no difference was noted in outcome - showing a statistically significant 48% less likelihood of intubation in the group treated with NIV, RR 0.52 (95% CI 0.35, 0.77), except for the marked reduction in heterogeneity, I^2=6% (Figure 2).

Length of ICU Stay

Three studies included ICU length of stay in their outcomes. Our analysis shows that patients given NIV had significantly shorter stays in the ICU, with 1.18 days less in the NIV group (95% CI 1.54 to 0.52 days less) compared to those given conventional oxygen therapy. The results of this analysis is homogenous, I^2=10% (Figure 3).

Table I. Baseline characteristics of studies included

Study	Patients NIV/ Conventional O2	Gender (M/F)		Mean age (years)		Outcomes
		NIV	Conventional O2	NIV	Conventional O2	
Antonelli 2000	20/20	13/7 (0.65/0.35)	12/8 (0.60/0.40)	45	44	Intubation rates, development of complication, duration of stay in the ICU, duration of ventilator assistance, death in the ICU
Hilbert 2001	26/26	18/8 (0.69/0.30)	19/7 (0.73/0.26)	48	50	Intubation rates, development of complications, length of stay in the ICU, duration of ventilator assistance, death in the ICU, death in the hospital
Lemiale 2015	191/183	117/74 (0.61/0.40)	105/78 (0.54/0.42)	64	61	28 day mortality, intubation rates, sequential organ failure assessment scre on day three, ICU acquired infections, duration of mechanical ventilation, ICU length of stay
Wermke 2012	42/44	32/10 (0.76/0.22)	37/7 (0.88/0.15)	42	44	Intubation rate, ICU admission rate, 100 day mortality, long term survival

Table II. Baseline characteristics of studies included

Characteristics of included studies

Domain	**Population**	**Inclusion**	**Exclusion**	**NIV**	**Conventional O2 Therapy**
Study 1 Antonelli 2000 N: 40	Solid Organ transplant patients with respiratory failure	RR > 35 PaO2/FiO2 < 200 *accessory musle use *paradoxical abdominal breathing	MV Requirement CP Arrest Hemodynamic instability Status Asthmaticus Neurologic cause Tracheostomy Facial deformities Recent oral, esophageal, gastric surgery 2 or more organ failures	Full face mask with an inflatable soft cushion seal. Goal ETV of 8mL/kg PEEP 2-3cm until 10cmH2O, FiO2 0.6 and less	Venturi Mask with FiO2 $\geq$ 0.4 to achieve PaO2 of 90%
Study 2 Hilbert 2001 N: 52	Immunosuppressed patients with fever, pulmonary infiltrates and early hypoxemic respiratory failure	RR > 30, Fever > 38.3C, Pulmonary infiltrates PaO2/FiO2 < 200	MV Requirement CP Arrest, GCS $\leq$ 8 SBP < 80mmHg MI or Ventricular Arrhythmias, RF of cardiac origin, COPD Recent 2 or more organ failures Facial deformities Recent oral, esophageal, gastric surgery PCO2 > 55, pH < 7.35 Uncorrected bleeding	Face mask in Pressure-Support mode. Goal ETV of 7-10mL/kg PEEP 2-3cm until 10cmH2O, FiO2 0.65 and less	Venturi Mask adjusted to achieve peripheral saturations >90%
Study 3 Lemiale 2015 N: 375	Immune deficiency Age > 18 Hematologic or solid organ malignancy Solid organ transplant Long term immunosupresive drug or steroid use	Acute hypoxemic failure (RR>30, PaO2 < 60mmHg, labored breathing, respiratory distress, dyspnea at rest) less than 72hrs	MV requirement Cardiogenic Edema MI, GCS < 13, pressor support Pregnancy, MI or ACS Pneumothorax, vomiting, inability to protect airway, PCO2 > 50	Goal ETV of 8mL/kg PEEP between 2-10cmH2O PEEP and FiO2 adjusted to maintain 92% SpO2 60minute sessions Q4h	Oxygen modality at the discretion of the physician
Study 4 Wermke 2012 N: 86	Patients who underwent hematopoietic stem cell transplant with respiratory failure	RR > 25 O2 Saturation < 92% PaO2/FiO2 < 300	MV Requirement Cardiac origin for RF Hemodynamic Instability requiring pressor support LF failure with pulmonary edema GCS < 8	Full-face mask with cushion PEEP 7mbar, PS 15mbar Administered intermittently 30mins Q3h	Nasal insufflation or full face mask starting at 3L/min

Study or Subgroup	NIV Events	NIV Total	Oxygen Alone Events	Oxygen Alone Total	Weight	Risk Ratio M-H, Random, 95% CI
Antonelli 2000	4	20	14	20	13.7%	0.29 [0.11, 0.72]
Hilbert 2001	12	26	20	26	29.8%	0.60 [0.38, 0.96]
Lemiale 2015	73	191	82	183	42.3%	0.85 [0.67, 1.09]
Wermke 2012	6	42	11	44	14.2%	0.57 [0.23, 1.41]
Total (95% CI)		**279**		**273**	**100.0%**	**0.62 [0.42, 0.93]**
Total events	95		127			

Heterogeneity: $Tau^2 = 0.08$; $Chi^2 = 6.54$, df = 3 (P = 0.09); $I^2 = 54\%$
Test for overall effect: Z = 2.30 (P = 0.02)

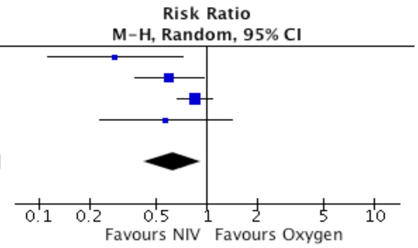

Figure 1. Forrest plot of pooled analysis comparing intubation rates between NIV and conventional therapy

Study or Subgroup	NIV Events	NIV Total	Oxygen Alone Events	Oxygen Alone Total	Weight	Risk Ratio M-H, Random, 95% CI
Antonelli 2000	4	20	14	20	17.9%	0.29 [0.11, 0.72]
Hilbert 2001	12	26	20	26	63.3%	0.60 [0.38, 0.96]
Lemiale 2015	73	191	82	183	0.0%	0.85 [0.67, 1.09]
Wermke 2012	6	42	11	44	18.8%	0.57 [0.23, 1.41]
Total (95% CI)		**88**		**90**	**100.0%**	**0.52 [0.35, 0.77]**
Total events	22		45			

Heterogeneity: $Tau^2 = 0.01$; $Chi^2 = 2.12$, df = 2 (P = 0.35); $I^2 = 6\%$
Test for overall effect: Z = 3.22 (P = 0.001)

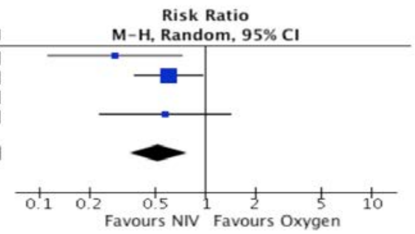

Figure 2. Forrest plot of sensitivity analysis comparing intubation rates between NIV and conventional therapy

Study or Subgroup	NIV Mean	NIV SD	NIV Total	Oxygen Mean	Oxygen SD	Oxygen Total	Weight	Mean Difference IV, Random, 95% CI
Antonelli 2000	7	5	20	10	6	20	3.6%	−3.00 [−6.42, 0.42]
Hilbert 2001	7	3	26	9	4	26	10.9%	−2.00 [−3.92, −0.08]
Lemiale 2015	6	2.1667	191	7	2.1667	183	85.4%	−1.00 [−1.44, −0.56]
Total (95% CI)			**237**			**229**	**100.0%**	**−1.18 [−1.84, −0.52]**

Heterogeneity: $Tau^2 = 0.08$; $Chi^2 = 2.22$, df = 2 (P = 0.33); $I^2 = 10\%$
Test for overall effect: Z = 3.50 (P = 0.0005)

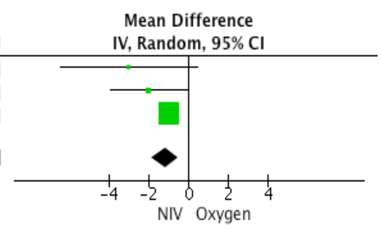

Figure 3. Forrest plot of pooled analysis comparing length of icu stay between NIV and conventional therapy

Study or Subgroup	NIV Events	NIV Total	Oxygen Events	Oxygen Total	Weight	Odds Ratio M-H, Random, 95% CI
Antonelli 2000	4	20	10	20	27.8%	0.25 [0.06, 1.02]
Hilbert 2001	10	26	18	26	33.6%	0.28 [0.09, 0.88]
Wermke 2012	12	44	11	44	38.7%	1.13 [0.43, 2.91]
Total (95% CI)		**90**		**90**	**100.0%**	**0.46 [0.17, 1.29]**
Total events	26		39			

Heterogeneity: $Tau^2 = 0.47$; $Chi^2 = 4.72$, df = 2 (P = 0.09); $I^2 = 58\%$
Test for overall effect: Z = 1.47 (P = 0.14)

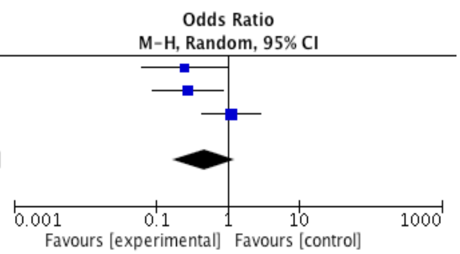

Figure 4. Forrest Plot of pooled analysis comparing ICU Mortality between NIV and conventional therapy.

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Odds Ratio M-H, Fixed, 95% CI
Antonelli 2000	7	20	11	20	12.7%	0.44 [0.12, 1.57]
Hilbert 2001	13	26	21	26	18.6%	0.24 [0.07, 0.82]
Lemiale 2015	46	191	50	183	68.7%	0.84 [0.53, 1.34]
Wermke 2012	30	44	27	44	0.0%	1.35 [0.56, 3.25]
Total (95% CI)		**237**		**229**	**100.0%**	**0.68 [0.45, 1.02]**
Total events	66		82			

Heterogeneity: $Chi^2 = 4.02$, df = 2 (P = 0.13); $I^2 = 50\%$
Test for overall effect: Z = 1.86 (P = 0.06)

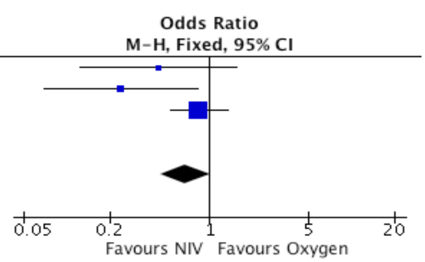

Figure 5. Forrest Plot of pooled analysis comparing all-cause mortality between NIV and conventional therapy.

Table III. Assessment of risk of bias in included studies

DOMAIN	Sequence Generation	Allocation Concealment	Blinding			Incomplete Outcome	Selective Outcome reporting	Over-all risk of bias
			Participants	Personnel	Outcome Assessor			
Study 1 Antonelli 2000	A	A	B	B	B	N/A	A	A
Study 2 Hilbert 2001	A	A	B	B	B	N/A	A	A
Study 3 Lemiale 2015	A	A	B	B	B	N/A	A	A
Study 4 Wermke 2012	A	A	B	B	B	N/A	A	A

Legend: A – Low Risk, B – Unclear Risk, C – High Risk

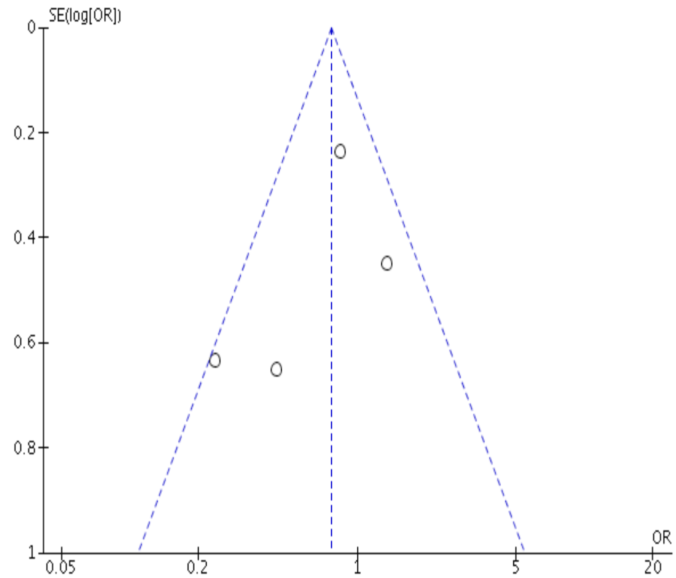

Figure 6. Funnel plot of studies included

ICU Mortality

Three studies, which included a total of 180 patients, analysed mortality in the ICU as an outcome. There was a 54% decrease in ICU mortality among patients given NIV, RR 0.46 (95% CI 0.17, 1.29), this result was however non-significant and heterogenous I^2=58% (Figure 4).

All-cause mortality

All four included studies included mortality from all causes in their outcome. There was no significant difference in the mortality from all causes in the analysis performed, RR of death is 0.77 (95% CI 0.53,1.11), and was not heterogenous I^2=49%. Sensitivity analysis for this outcome was performed, and we removed the study of Wermke because it analysed only patients admitted in the wards, and not in the ICU. Post sensitivity analysis, there is an observed 32% less chance of dying from all-causes in the NIV group versus the group treated with conventional oxygen therapy, however it was not statistically significant, RR 0.68 (95% CI 0.53-1.11) and heterogenous I^2=50% (Figure 5).

Publication Bias

A funnel plot comparing all-cause mortality between NIV and the conventional oxygen therapy group was made to check for publication bias. The scatter plot showed an assymetrical distribution suggesting publication bias.

Discussion

Of the four studies included, RCTs[12,13] showed no significant benefit with NIV in immunocompromised patients with respiratory failure, while the other studies[10,11] concluded benefit in clinical outcomes. Additionally, with the varying population per study included, there was an expected substantial heterogeneity. Despite this, our results were consistent and has shown that the use of NIV significantly reduced the rate of intubation, length of stay in the ICU. Furthermore, though outcome in ICU mortality and all-cause mortality was non-significant, and despite the heterogeneity, the trend remained toward mortality reduction. This meta-analysis has now given important clinical outcomes with NIV use, and its future interventional application.

The studies covered patients with hematologic or solid cancers, immune deficiency, immunosuppresive drug use, hematopoietic stem cell transplant, which was a well representation of the immunocompromised population. Looking at NIV related complications, reports included only facial necrosis[10], facial abrasions[11], while all fatal complications were from organ dysfunction and none was directly associated with its use.

Given the significant clinical outcomes - preventing mechanical intubation, and its associated complications, trend toward mortality reduction – and the limited non-fatal complications of NIV, we conclude that NIV is now an option for immunocompromised patients with respiratory failure.

Conclusion

Among immunocompromised patients with respiratory failure, NIV compared with standard oxygen support significanlty reduced intubation, and ICU length of stay. This intervention also showed trend toward ICU and all-cause mortality reduction.

Limitations

The main limitations were the limited number of studies that met the criteria for inclusion, and the different subpopulations within each study. The funnel plot (Figure 6) was asymetric suggesting publication bias, most likely due to the limited number, and heterogeneity of the studies, but does not exclude the limitations within the studies.

Recommendations

More studies with equally distributed subpopulations of immunocompromised hosts are needed to further strengthen the results made in this meta-analysis, specifically mortality benefits. Further studies can also incorporate subgroup analyses to compare outcomes. Additionally, the definition of immunocompromised patient remains to be broad, and this makes way for identifying similar populations who may benefit from the intervention. The studies included gave clear clinical criteria for inclusion, and this may be consolidated to formulate an approach or a guideline for patients with similar conditions.

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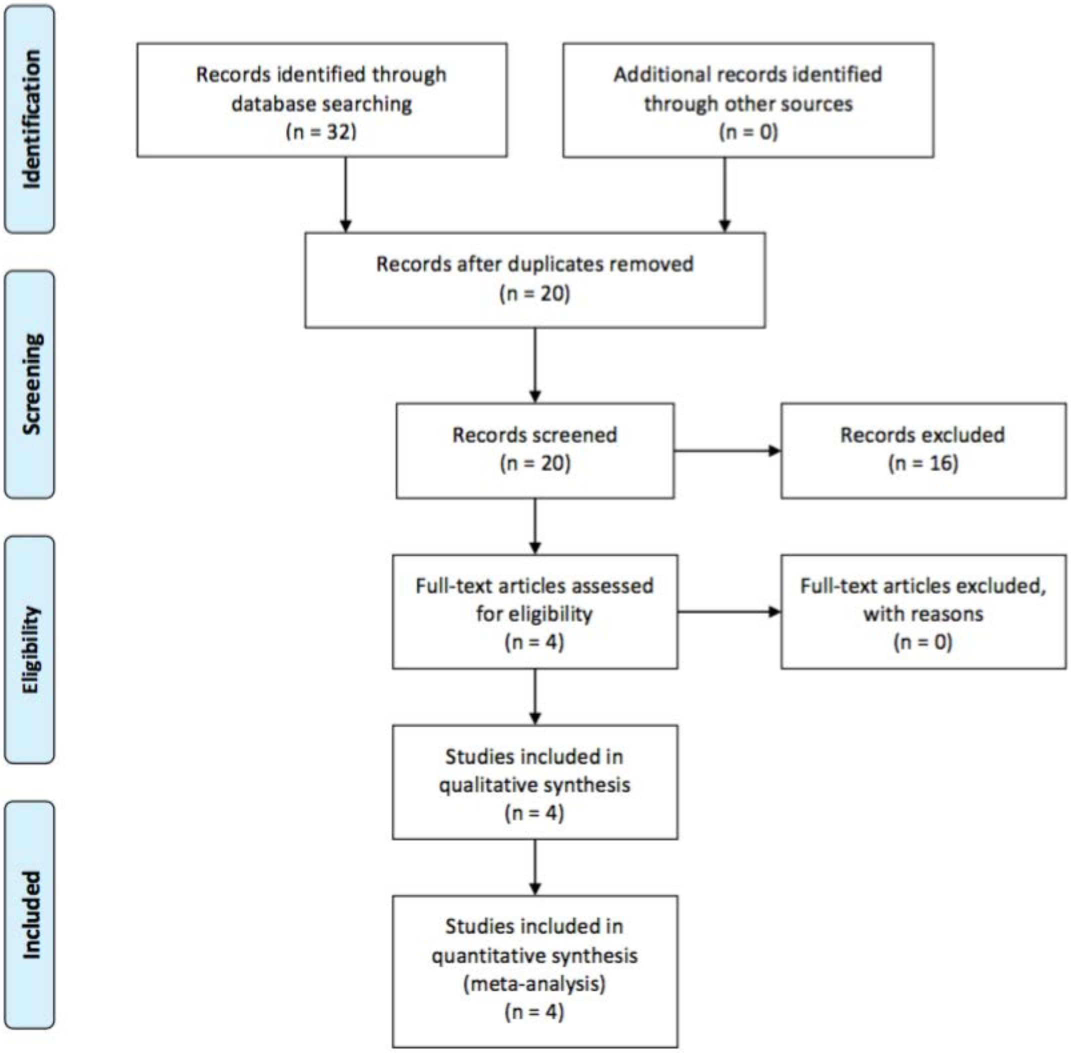
Appendix A. PRISMA Chart of studies identified, screened, reviewed for eligibility and included.



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Appendix B. Sample Data Extraction Template

Trial ID	Extractor:	Year of publication:
Title		
Authors		

Participants

Inclusion criteria: Exclusion criteria:

Experiment group: Control group:

Risk of Bias Table

Domain	Judgement Low Risk/ High Risk/ Unclear	Support for Judgement/ Description
Method of Random sequence Generation (Selection Bias)		
Method of allocation Concealment (Selection Bias)		
Incomplete Outcome Data/Loss of participants to follow up (Attrition Bias)		
Blinding of Participants and Personnel (Performance Bias)		
Blinding of Outcome Assessment (Detection Bias)		
Selective Reporting/ Intention to treat analysis (Reporting Bias)		
Other Bias		

Additional information requested

Notes

Outcomes

	Outcome Measures (Dichotomous)	Total women =			
		Intervention group n =		Control group n =	
		events	total	events	total
	Primary:				
1					
	Secondary:				
2					
3					

----------------------------------END OF SAMPLE DATA EXTRACTION------------------------------------

Sample search strategy:

PubMed

History

Download history Clear history

Search	Add to builder	Query	Items found	Time
#27	Add	Search (#26) AND #1 Filters: Randomized Controlled Trial	0	09:23:19
#28	Add	Search (#26) AND #1 Schema: all Filters: Randomized Controlled Trial	0	09:23:19
#26	Add	Search HIV[MeSH Terms] Filters: Randomized Controlled Trial	2482	09:23:00
#25	Add	Search (#24) AND #1 Filters: Randomized Controlled Trial	1	09:22:28
#24	Add	Search Solid Tumors[MeSH Terms] Filters: Randomized Controlled Trial	853	09:21:26
#23	Add	Search (#1) AND #21 Schema: all Filters: Randomized Controlled Trial	0	09:20:34
#22	Add	Search (#1) AND #21 Filters: Randomized Controlled Trial	0	09:20:34
#21	Add	Search immunosuppression[MeSH Terms] Filters: Randomized Controlled Trial	1636	09:20:12
#20	Add	Search Immunocompromised Host[MeSH Major Topic] Filters: Randomized Controlled Trial	66	09:19:10
#2	Add	Search Immunocompromised Host[MeSH Major Topic]	6784	09:19:00
#19	Add	Search (immunocompromised patient[MeSH Major Topic] AND Randomized Controlled Trial[ptyp]) Filters: Randomized Controlled Trial	66	09:18:30
#18	Add	Search immunocompromised patient[MeSH Major Topic] Filters: Randomized Controlled Trial	66	09:18:02
#12	Add	Search hematologic malignancy[MeSH Major Topic] Filters: Randomized Controlled Trial	174	09:16:17
#16	Add	Search (#15) AND #1 Filters: Randomized Controlled Trial	0	09:14:37
#17	Add	Search (#15) AND #1 Schema: all Filters: Randomized Controlled Trial	0	09:14:37
#15	Add	Search solid organ transplant[MeSH Major Topic] Filters: Randomized Controlled Trial	82	09:14:13
#14	Add	Search (#1) AND #12 Schema: all Filters: Randomized Controlled Trial	0	09:12:58
#13	Add	Search (#1) AND #12 Filters: Randomized Controlled Trial	0	09:12:58
#11	Add	Search (#10) AND #1 Filters: Randomized Controlled Trial	2	09:11:31
#10	Add	Search Immunosuppressed Patient[MeSH Major Topic] Filters: Randomized Controlled Trial	66	09:10:54
#9	Add	Search Immunosuppressive drug use[MeSH Major Topic] Schema: all Filters: Randomized Controlled Trial	0	09:09:46
#8	Add	Search Immunosuppressive drug use[MeSH Major Topic] Filters: Randomized Controlled Trial	0	09:09:46
#7	Add	Search (#5) AND #1 Schema: all Filters: Randomized Controlled Trial	0	09:09:08
#6	Add	Search (#5) AND #1 Filters: Randomized Controlled Trial	0	09:09:08
#5	Add	Search Immunosuppression[MeSH Major Topic] Filters: Randomized Controlled Trial	1048	09:08:06
#4	Add	Search (#2) AND #1 Filters: Randomized Controlled Trial	2	09:06:32
#3	Add	Search (#2) AND #1	7	09:05:16
#1	Add	Search Non Invasive Ventilation[MeSH Major Topic]	669	09:03:14

Google Scholar

allintitle: Non Invasive Ventilation Transplant

4 results (0.09 sec)

[CITATION] **Non-Invasive Ventilation** Aggressive Titration To Optimize Response (nivator): Feasibility Assessment In Children Post-Hematopoetic Cell **Transplant**
K Walsh, C Duncan, M Lilley... - AMERICAN ..., 2015 - ... SOC 25 BROADWAY, 18 FL, NEW ...
Cite Save

Non-Invasive Ventilation Aggressive Titration To Optimize Response (NIVATOR): Feasibility Assessment In Children Post-Hematopoetic Cell **Transplant**
C Duncan, M Lilley, J Traver, AG Randolph, K Walsh - Mortality, 2015 - Am Thoracic Soc
Background: Noninvasive **ventilation** (NIV) is increasingly used post-HCT with the goal of preventing intubation and **invasive** mechanical ventilator (IMV) support. We developed an explicit protocol for aimed at ggressive itration to ptimize esponse (NIVATOR) and ...
Cite Save

... -HF Study1370Magnetic Resonance Adenosine Perfusion Imaging as Gatekeeper of **Invasive** Coronary1509Influence of **non-invasive** hemodynamic CMR parameters ...
TA Treibel, F Duca, J Schwitter... - Eur Heart J ..., 2016 - ehjcimaging.oxfordjournals.org
Abstracts 1575Extracellular volume associates with outcomes more strongly than native or post-contrast myocardial T1 1507Cardiac Magnetic Resonance measured Extracellular Volume Independently Predicts Adverse Outcome in Heart Failure with Preserved Ejection ...
Cite Save

... ventricleP715Prognostic value of pulmonary arterial pressure: analysis in a large dataset of timely matched **non-invasive** and **invasive** assessmentsP716Effect of the ...
R Winter, A Fazlinezhad... - Eur Heart J ..., 2015 - ehjcimaging.oxfordjournals.org
Purpose: We developed a transthoracic echo simulator that can measure psychomotor skill in echo to assist in training as well as for certification of competence. The simulator displays cine loops on a computer in response to the user scanning a mannequin with a mock ...
Cite Save

Cochrane Database

Cochrane Reviews (0)
All
Review
Protocol
Other Reviews (0)
Trials (6)
Methods Studies (0)
Technology Assessments (0)
Economic Evaluations (0)
Cochrane Groups (0)

All
Current Issue

Me Methodology
Dx Diagnostic
Ov Overview
Pg Prognosis
Qu Qualitative
Cc Conclusions changed
Ns New search
Mc Major change
Up Update
Wd Withdrawn
Cm Comment

There are **6** results from **975969** records for your search on **'"Non Invasive Ventilation" and "cancer" in Title, Abstract, Keywords** in **Trials'**

Sort by Relevance: high to low

Select all | Export all | Export selected

Evaluation of preoperative **non-invasive ventilation** in thoracic surgery for lung **cancer** : The preOVNI study GFPC 12-01. [French]
Paleiron N , Andre M , Grassin F , Chouaid C , Venissac N , Margery J , Couturaud F , Noel-Savina E , Tromeur C , Vinsonneau U , Vedrine L , Leroyer C , Nowak E , Berard H , Thomas P , Brouchet L , Bagan P , Fournel P , Mottier D and Robinet G
Revue des maladies respiratoires, 2013, 30(3), 231
Publication Year: 2013

[Evaluation of preoperative **non-invasive ventilation** in thoracic surgery for lung **cancer** : the preOVNI study GFPC 12-01].
Paleiron N , André M , Grassin F , Chouaïd C , Venissac N , Margery J , Couturaud F , Noël-Savina E , Tromeur C , Vinsonneau U , Vedrine L , Leroyer C , Nowak E , Berard H , Thomas P , Brouchet L , Bagan P , Fournel P , Mottier D and Robinet G
Revue des maladies respiratoires, 2013, 30(3), 231
Publication Year: 2013

Multicenter randomized study of the use of **non-invasive ventilation** (NIV) vs oxygen therapy (02) in reducing respiratory distress in end stage **cancer** patients [Abstract]
Nava S , Esquinas A , Ferrer M , Groff P , Scala R , Gonzalez Diaz G , Naldi M , Ceriana P and Cuomo AM
American Thoracic Society International Conference, May 16-21, 2008, Toronto, 2008, A767
Publication Year: 2008

Multicenter randomised study of the use of **non-invasive ventilation** (NIV) vs oxygen therapy (02) in reducing dyspnea in end-age solid **cancer** patients with respiratory failure and distress [Abstract]
Nava S , Esquinas Ferrer M , Groff P , Scala R , Gonzalez Diaz G , Naldi M and Cuomo AM
European respiratory journal, 2007, 30(Suppl 51), 204s [1270]
Publication Year: 2007

Palliative use of **non-invasive ventilation** in end-of-life patients with solid tumours: a randomised feasibility trial.
Nava S , Ferrer M , Esquinas A , Scala R , Groff P , Cosentini R , Guido D , Lin CH , Cuomo AM and Grassi M
The Lancet. Oncology, 2013, 14(3), 219
Publication Year: 2013