

Original Article

Role of Non-Invasive Mechanical Ventilation for Acute Respiratory Failure in Cancer Patients

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ABSTRACT

Introduction: Acute respiratory failure is a common cause of Intensive care Unit admission for cancer patients. Noninvasive ventilation comes in between the two extreme situations: either provide only oxygen or ventilate invasively. This study was done to find the usefulness and efficacy of noninvasive ventilation in a cancer patient.

Materials and Methods: A cross-sectional study was done at Nepal Cancer Hospital. Data analysis of patients requiring noninvasive ventilation at the Intensive care Unit from April 14, 2018, to April 13, 2019, were included.

Results: Among 68 studied patients, the primary reason for the initiation of noninvasive ventilation sepsis (16.32%), pneumonia (10.88%), and lung cancer (10.2%). Postoperative atelectasis, pulmonary edema, and morphine overdose were associated with good respiratory improvement and Intensive care Unit survival (100%, 75% and 66.67% respectively). Respiratory failure with carcinoma lung, lung fibrosis, acute respiratory distress syndrome, terminally ill patients, and patients with low Glasgow Coma Scale had high failure rates (Survival: 13.33%, 14.29%, 16.67%, 0%, and 20% respectively).

Conclusions: Noninvasive ventilation seems to be an effective way of ventilation for cancer patients. The selection of patients and timely initiation of noninvasive ventilation is of utmost importance for a better outcome.

Keywords: Intensive care unit; Lung Carcinoma; Noninvasive ventilation; Pneumonia

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Submitted: 31st March 2020

Accepted: 18th June 2020

Source of Support: None

Conflict of Interest: None



Citation: Basnet MB, Acharya KP, Adhikari D. Role of non-invasive mechanical ventilation for acute respiratory failure in cancer patients. *NMJ* 2020;3(1):298-301. DOI 10.3126/nmj.v3i1.28289

INTRODUCTION

Acute Respiratory Failure is one of the most common causes of (Intensive care unit) ICU admission for cancer patients.¹ However invasive mechanical ventilation for severe respiratory failure is a strong predictor of mortality in cancer patients.² Hence, at present, the use of Noninvasive ventilation (NIV) is increasing. NIV has been shown to decrease the need for intubation and mortality in an acute care setting.³ NIV is used for both hypoxemic respiratory failure as well as hypercapnic respiratory failure.⁴

Although it is well accepted that intubation and mechanical ventilation should be avoided in cancer patients with acute respiratory failure and NIV is one of the most promising alternatives. However, cancer patients are a diverse group with many variations and confounding factors. Hence, it is important to determine which patients may benefit from NIV. Identification is crucial for both medical and ethical point of view. Hence, the study is to determine the usefulness and efficacy of NIV in the cancer patient.

The objective of this study is to assess the role (indications, utility, and outcome) of NIV in cancer patients admitted to ICU for medical or surgical issues.

MATERIALS AND METHODS

It is a cross-sectional study done at the Nepal Cancer Hospital and Research Center. Data of all patients requiring Non-Invasive ventilation from April 14, 2018, to April 13, 2019, at Intensive Care Unit were collected in a performa, tabulated in a master sheet in Microsoft excel 2013, and analyzed manually as well as in SPSS ver 16.0. Relevant statistical tools (Chi-Squared test, fisher’s exact test for categorical data and student T-test for continuous data, odds ratio, and Confidence interval) were used.

RESULTS

During the study period, 71 patients required NIV support. Among them, 68 patients were included in the study, as 3 patients’ data were missing. The mean age of the patients was 57.57+/-14.95 years while 30.88% were female. Age and gender were not significant for improvement/tolerance and survival. The primary reason for the initiation of noninvasive ventilation is given in table 1. The most common reasons being a respiratory failure are due to sepsis (neutropenic and non-neutropenic), pneumonia, and lung cancer.

Table 1: Primary reason for initiation of noninvasive ventilation

Reason for NIV	No of cases	Survival (30) %	Odds ratio	95% CI	Improve (31)%	Odds ratio	95% CI
Pulmonary edema	8	75.00%	4.5	0.837 - 24.183	75.00%	4.2	0.782 - 22.549
Post op atelectasis	5	100.00% *			100.00% *		
Morphine	3	66.67%	2.643	0.228 - 30.631	66.67%	2.483	0.214 - 28.764
Lung fibrosis	7	14.29%	0.184	0.021 - 1.62	14.29%	0.172	0.02 - 1.517
Neutropenic sepsis	9	44.44%	1.015	0.247 - 4.166	44.44%	0.948	0.231 - 3.888
Ca lung	15	13.33% *	0.137	0.028 - 0.669	0.00%	*	
Low GCS	10	20.00%	0.268	0.052 - 1.371	40.00%	0.765	0.195 - 3.001
COPD	10	50.00%	1.32	0.344 - 5.062	40.00%	0.765	0.195 - 3.001
ARDS	6	16.67%	0.228	0.025 - 2.063	16.67%	0.213	0.024 - 1.933
MODS/Sepsis	15	33.33%	0.56	0.168 - 1.862	33.33%	0.519	0.156 - 1.726
Gasping	6	0.00% *			0.00% *		
Pneumonia	16	50.00%	1.364	0.443 - 4.195	50.00%	1.261	0.41 - 3.874

Ca: Carcinoma; GCS: Glasgow coma scale; COPD: Chronic obstructive pulmonary disease; ARDS: Acute respiratory distress syndrome; MODS: Multiple organ dysfunction syndrome

Postoperative atelectasis, pulmonary edema, and morphine overdose were associated with good respiratory improvement and ICU survival. Respiratory failure with carcinoma lung, lung fibrosis, ARDS, terminally ill gasping patients, and patients with low GCS had high failure rates. While pneumonia, neutropenic sepsis, and COPD may also have some benefit.

Patients with both hypoxemic and hypercapnic respiratory failure were supported with NIV. However, the differences in outcomes were not statistically significant. All 7 patients who received NIV Support with anticipation of respiratory failure (such as

postoperative atelectasis) but not hypoxemic or hypercapnic had a good outcome (p=0.003).

Interestingly in patients not improving with NIV, ABG parameters were significantly worse and had higher oxygen requirements before initiating NIV than those patients improving with NIV. The ABG parameters seem to improve and attain a much better value in patients improving with NIV. The initial ABG value just before the initiation of NIV is given in table 2. The ABG Values at 1 hour of initiating NIV is given in table 3.

	Survive n=30	Mean	SD	p-value	Improved n=31	Mean	SD	p-value
ph_1	No	7.30	0.14	0.018	No	7.31	0.16	0.123
	Yes	7.38	0.11		Yes	7.36	0.09	
po2_1	No	86.37	34.82	0.007	No	84.59	34.36	0.002
	Yes	113.97	46.53		Yes	115.19	45.51	
pco2_1	No	52.76	14.20	0.005	No	53.43	14.28	0.001
	Yes	43.23	12.49		Yes	42.74	11.88	
fio2_1	No	72.37	25.41	0.000	No	74.05	24.32	0.000
	Yes	47.67	14.31		Yes	46.45	14.04	
po2fio2_1	No	1.46	1.01	0.000	No	1.37	0.98	0.000
	Yes	2.60	1.25		Yes	2.67	1.18	

P<0.05- significant

Table 3: ABG Values at 1 hour after initiating noninvasive ventilation

	Survive n=30	Mean	SD	p-value	Improved n=31	Mean	SD	p-value
ph₁	No	7.30	0.14	0.018	No	7.31	0.16	0.123
	Yes	7.38	0.11		Yes	7.36	0.09	
po₂₁	No	86.37	34.82	0.007	No	84.59	34.36	0.002
	Yes	113.97	46.53		Yes	115.19	45.51	
pcO₂₁	No	52.76	14.20	0.005	No	53.43	14.28	0.001
	Yes	43.23	12.49		Yes	42.74	11.88	
fiO₂₁	No	72.37	25.41	0.000	No	74.05	24.32	0.000
	Yes	47.67	14.31		Yes	46.45	14.04	
po₂fiO₂₁	No	1.46	1.01	0.000	No	1.37	0.98	0.000
	Yes	2.60	1.25		Yes	2.67	1.18	

P<0.05- significant

The highest Inspiratory Positive Airway Pressure(IPAP) required was 10.19 cmH₂O in the improved group and 11.83 cmH₂O in patients who did not improve with NIV. Similarly, the highest Expiratory Positive Airway Pressure (EPAP) was 5.19 cmH₂O in an improved group whereas it was 6.08 cmH₂O in the group which did not improve with NIV. The highest FiO₂ was less in the patients' group who improved with NIV in comparison with not improving the group.

Regarding co-morbidities, 2 patients with CCF received NIV support without any benefit. Patients with acute renal failure also had poor outcomes than those with COPD or DM although the values were not statistically significant.

Patients with lung cancer had significantly low improvement

(0%) and survival rate while those with malignancy other than lung and hematological (5.88%) had statistically significant improvement (39.71%). Patients with metastasis had poor outcome (32.6% vs 72.73%; *p*=0.002). Interestingly, patients with "Do Not Resuscitate"(DNR) status had poor outcome than those without DNR Status (9.1% vs 78.26%, *p*=0.001).

Regarding the reason for ICU admission, patients admitted for post-operative, respiratory, or cardiac cause had better outcome while those admitted for renal, metabolic, and neurologic reasons had worse outcomes. 45.59% of patients who got NIV support improved. 90.32% of these patients were survived and discharged from ICU. Among the NIV failure, Intolerance, intubation, and cardiac arrest leading to CPR were the commonest reason for termination of NIV support (Table 4). Whatever the reason, survival rates after NIV failure had significantly poor outcomes.

Table 4: Reasons for Non-Invasive Ventilation failure and their outcomes

Reason for NIV	No of cases	Survival (30) %	Odds ratio	95% CI	Improve (31)%	Odds ratio	95% CI
Leak	9	11.11%	0.129	0.015 - 1.1	11.11%	*	0.014 - 1.028
Intolerance	15	26.67%	0.378	0.107 - 1.338	13.33%	*	0.026 - 0.621
Intubated	13	15.38%	* 0.175	0.036 - 0.866	0.00%	*	
CPR	13	0.00%	*		0.00%	*	
Withdrawal	11	0.00%	*		0.00%	*	

p<0.05- Significant

DISCUSSION

Noninvasive ventilation has been perceived as the most promising alternative to endotracheal intubation. However, cancer patients are a diverse group and the need for respiratory support is also varied. This study aims to describe the indication, uses, and limitations of NIV.

In this study of 68 cancer patients, being treated medically or surgically and requiring NIV were observed, 45.59% patient improved while 44.18% patient had survived and discharged from ICU. Our results are in accordance with the results published by A.P meert⁵ who showed a success rate of 57.5% in a retrospective study of 40 cancer patients. Another study done by Azoulay et al.⁶ also showed a crude ICU discharge rate of 56.3% in a cohort study of 48 cancer patients exposed to NIV. Interestingly, our study shows that noninvasive ventilatory assistance is also an

effective and safe alternative to standard mechanical ventilation in cancer patients. Among 31 improved patients, 28 i.e. 90.3% of patients were discharged from ICU as survived patients.

According to the study carried out by Carlson Robert H⁷, noninvasive ventilation is more effective than standard oxygen therapy in reducing the respiratory rate, dyspnea and also reduces patients' reliance on morphine and preserves normal swallowing, speech and cough mechanism in cancer patients. This effect can be explained by the fact that BiPAP is effective in correcting gas exchange abnormalities. Cancer patients are often frail and anemic because of their underlying disease and subsequent treatment (chemotherapy/radiotherapy/surgery). When increased work of breathing is needed to maintain oxygenation, the demand of the respiratory muscles can become excessive, causing fatigue and carbon dioxide retention. BiPAP is effective in improving oxygenation, recruiting under-ventilated alveoli, preventing

alveolar collapse, and reducing the work of breathing. In a study done by Cuomo et al⁸, among 23 cancer patients, 53% have survival rates with the support of NIV.

In our study, the main cause for the use of NIV is pneumonia with a survival rate of 50% followed by ca lung and sepsis with a survival rate of 13% and 33% respectively. Our Study also reflects the significance of ABG in support of proper outcomes while using NIV. The outcome of patients with better ABG values at the initiation of NIV are significantly better thus suggesting earlier use of NIV could result in improved outcome. ABG value at 1 hour is also shown to be a good predictor of NIV success. This finding supplements the recommendation given by Pastores et al⁹ who suggested timely diagnosis and treatment of reversible causes of respiratory failure, including earlier use of noninvasive ventilation and judicious ventilator and fluid management in patients, are essential for achieving an optimal outcome.

NIV could be of particular importance in a cancer patient who are immuno-compromised and whom the risk of developing infections such as ventilator-associated pneumonia, sinusitis, and sepsis during mechanical ventilation is especially high. The endotracheal tube is one of the most significant factors predisposing patients to nosocomial pneumonia which it does by causing local damage and by by-passing the mechanical defenses of the upper airways.

NIV has been shown to involve a lower incidence of pneumonia than conventional mechanical ventilation. In the studies of Hilbert¹⁰ and Antonelli¹¹, 100% of immunosuppressed patients with ventilator-associated pneumonia died in ICU.

In our study, 41% of cancer patients were discharged from ICU

as the survived patient. This is in accordance with the literature. Tognet et al¹² reported a series of 18 patients with a success rate of 33%. Conti et al¹³ obtained a 68.7% success rate with BiPAP in a series of 16 selected hematological patients. In thrombocytopenic patients, bleeding due to intubation can be another problem. NIV can reduce this risk not only by avoiding endotracheal intubation but also by allowing oral nutrition without a nasogastric tube.

Finally, BiPAP ventilation offers an important advantage for patients for whom it has been decided not to perform such life-supportive critical care techniques as mechanical ventilation or for patients refusing intubation. This can be crucial in getting patients through an acute and reversible medical problem. Besides, even if respiratory failure is not resolved, NIV can attenuate dyspnea. Moreover, communication and physical interaction with relatives or medical and nursing staff can be maintained, since sedation remains minimal allowing more psychological comfort in end-of-life patients.

CONCLUSIONS

Noninvasive ventilation appears to be an effective ventilation approach for cancer patients. Judicial selection of patients and timely initiation of NIV is of utmost importance for a better outcome. Further prospective studies in larger patient populations are required to determine prognostic factors that can predict whether this supportive treatment will be successful in general cancer patient populations and take account of variables relating to both the respiratory failure and the underlying neoplastic disease. Other areas of interest will be studying noninvasive ventilation eases end of life for a cancer patient.

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