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Non-invasive ventilation – palliative care for an oncology patient

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Abstract

English:

Patients with neoplastic lung disease experience a decreased quality of life due to progressive respiratory dysfunction. The inclusion of non-invasive ventilation (NIV) in the management plan of these patients has been effective in relieving symptoms of acute respiratory failure, reducing respiratory effort and increasing sleep quality. A 48-year-old patient diagnosed with pulmonary adenocarcinoma (radio-chemo-treated) and COPD presented to the ER with the complaints of thoracalgia, dyspnoea and daytime fatigue. Initial tests showed hypoxemic respiratory failure, mild obstructive sleep apnoea syndrome and right medium pleural effusion. CPAP therapy was initiated but not tolerated by the patient and, therefore, we switched to NIV – BPAP (spontaneous mode) with satisfactory results. The literature indicates that NIV therapy has proved superior to oxygen therapy in cancer patients, relieving dyspnoea in patients with hypoxemic respiratory failure (regardless of $PaCO_2$ level). Moreover, NIV-treated patients required lower doses of opioids and reported an improved quality of life.

Keywords

non-invasive ventilation • NIV • BPAP • pleural effusion • obstructive sleep apnoea syndrome

Ventilația non-invazivă – tratament paliativ în cazul unui pacient oncologic

Rezumat

Romanian:

Pacienții cu neoplazii pulmonare au o calitate a vieții scăzută din cauza disfuncției respiratorii progresive. Includerea ventilației non-invazive în planul de management al acestor pacienți s-a dovedit a fi eficientă în ameliorarea simptomelor aferente insuficienței respiratorii acute, reducerea efortului respirator și creșterea calității somnului. Un pacient în vârstă de 48 de ani, diagnosticat cu adenocarcinom pulmonar (radiochimiotratat) și BPOC, s-a prezentat la Camera de Garda acuzând toracalgie, dispnee și oboseală diurnă. Testele inițiale au arătat insuficiență respiratorie hipoxemică, sindrom de apnee obstructivă ușoară în somn și revărsat pleural drept în cantitate medie. S-a inițiat terapia CPAP, însă nu a fost tolerată de pacient și, prin urmare, a fost schimbată cu VNI – BPAP (mod spontan) cu rezultate pozitive. Literatura de specialitate conferă terapiei cu VNI superioritate față de oxigenoterapie la pacienții oncologici, ameliorând dispneea la cei cu insuficiență respiratorie hipoxemică (indiferent de nivelul PaCO2). Mai mult, pacienții tratați cu VNI au necesitat doze mai mici de opioide și au raportat o calitate a vieții îmbunătățită.

Cuvinte-cheie

ventilație non-invazivă • VNI • BPAP • efuziune pleurală • sindromul de apnee obstructivă în somn • paliativ • oncologie • hipoxemie

Abbreviations: *ABG, arterial blood gas; AHI, apnoea/hypopnea index (quantified by events/hour); BPAP, bi-level positive airway pressure; COPD, chronic obstructive pulmonary disease; CPAP, continuous positive airway pressure; ECOG, Eastern Cooperative Oncology Group; EPAP, expiratory positive airway pressure; IPAP, inspiratory positive airway pressure; mMRC, modified Medical Research Council Dyspnoea Scale; NIV, non-invasive ventilation; ODI, oxygen desaturation index; $PaCO_2$, partial pressure of carbon dioxide in arterial blood; PaO_2, partial pressure of oxygen in arterial blood; SVC, superior vena cava; VM, vesicular murmur.*

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Introduction

Patients with neoplastic lung disease experience a decreased quality of life due to progressive respiratory dysfunction. Pain, progressive complications of neoplastic pathology or even iatrogenic complications significantly affect the quality of life of these patients.

Adopting the multidisciplinary approach is imperative so far as the treatment strategy used for neoplastic patients is concerned, and nowadays, it is being increasingly recognised that such treatment should not be limited merely to pain therapy and oncological treatment (surgical/radiotherapy/pharmacological). The inclusion of non-invasive ventilation (NIV) in the management plan of these patients has been shown to be effective in relieving symptoms of acute respiratory failure, reducing respiratory effort and increasing sleep quality.

Case presentation – clinical problems

A 48-year-old male patient, ex-smoker (30PA), with occupational exposure to respiratory noxious substances (rubber industry worker), known with adenocarcinoma in the right superior pulmonary lobe – T4N3M1a, which was surgically sanctioned and radio-chemo-treated (11 sessions), relapsing right pleural effusion, superior vena cava (SVC) syndrome and chronic obstructive pulmonary disease (COPD) GOLD stage II, presented to the hospital with the complaints of right posterior thoracalgia, dyspnoea at rest and daytime fatigue. Clinical examination revealed the following: altered general condition, upper body oedema, abdominal collateral circulation, thoracic venous ectasia (Figure 1), mMRC score = 4 and ECOG score = 4. Physical examination showed diminished vesicular murmur in the lower half of the right hemithorax and tachypnoea.

In the emergency room (ER), arterial blood was drawn from the radial artery, under oxygen therapy delivered via an oro-nasal mask (6 L/min), revealing hypoxemic respiratory failure (PaO_2 = 69 mmHg, $PaCO_2$ = 28.3 mmHg, SpO_2 = 93%). Chest X-ray showed right-sided opacity supporting the diagnosis of right pleural effusion in medium-high amounts (Figure 2).

A CT scan, which was performed 45 days prior to the current presentation, showed an adenopathic block with mass effect over the SVC and right upper lobar bronchus (Figure 3).



Figure 1. SVC syndrome**.** SVC, superior vena cava.

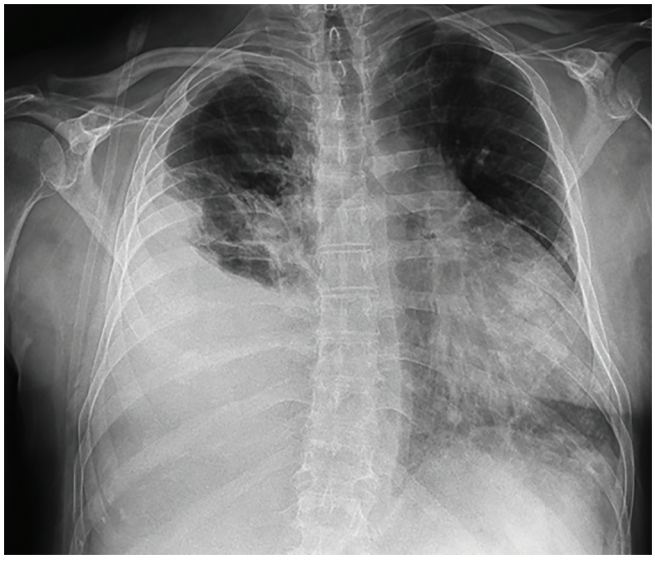


Figure 2. Chest X-Ray at admission.

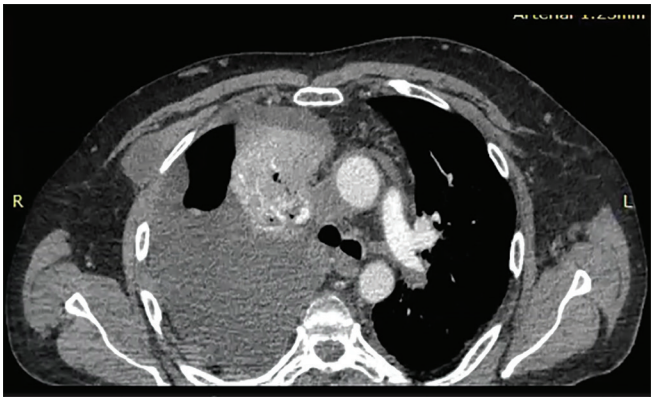
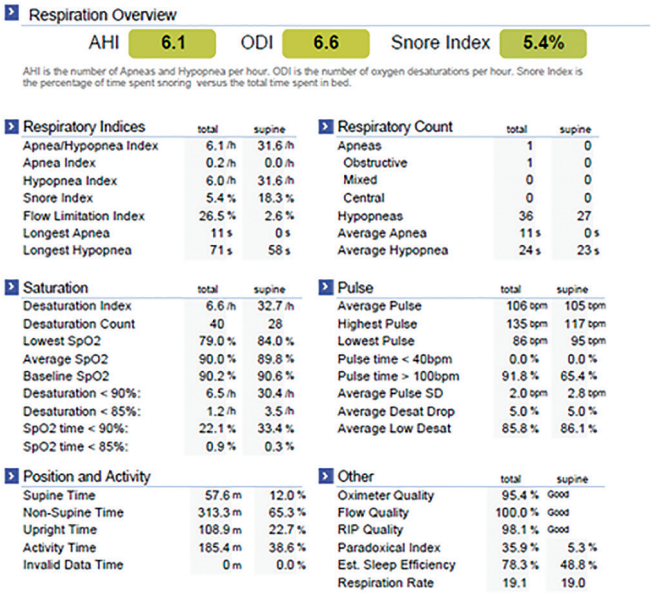


Figure 3. CT scan showing adenopathic mass and compression of SVC. SVC, superior vena cava.



Respiration Overview

AHI 6.1 ODI 6.6 Snore Index 5.4%

AHI is the number of Apneas and Hypopnea per hour. ODI is the number of oxygen desaturations per hour. Snore Index is the percentage of time spent snoring versus the total time spent in bed.

Respiratory Indices	total	supine
Apnea/Hypopnea Index	6.1 /h	31.6 /h
Apnea Index	0.2 /h	0.0 /h
Hypopnea Index	6.0 /h	31.6 /h
Snore Index	5.4 %	18.3 %
Flow Limitation Index	26.5 %	2.6 %
Longest Apnea	11 s	0 s
Longest Hypopnea	71 s	58 s

Respiratory Count	total	supine
Apneas	1	0
Obstructive	1	0
Mixed	0	0
Central	0	0
Hypopneas	36	27
Average Apnea	11 s	0 s
Average Hypopnea	24 s	23 s

Saturation	total	supine
Desaturation Index	6.6 /h	32.7 /h
Desaturation Count	40	28
Lowest SpO2	79.0 %	84.0 %
Average SpO2	90.0 %	89.8 %
Baseline SpO2	90.2 %	90.6 %
Desaturation < 90%:	6.5 /h	30.4 /h
Desaturation < 85%:	1.2 /h	3.5 /h
SpO2 time < 90%:	22.1 %	33.4 %
SpO2 time < 85%:	0.9 %	0.3 %

Pulse	total	supine
Average Pulse	106 bpm	105 bpm
Highest Pulse	135 bpm	117 bpm
Lowest Pulse	86 bpm	95 bpm
Pulse time < 40bpm	0.0 %	0.0 %
Pulse time > 100bpm	91.8 %	65.4 %
Average Pulse SD	2.0 bpm	2.8 bpm
Average Desat Drop	5.0 %	5.0 %
Average Low Desat	85.8 %	86.1 %

Position and Activity		
Supine Time	57.6 m	12.0 %
Non-Supine Time	313.3 m	65.3 %
Upright Time	108.9 m	22.7 %
Activity Time	185.4 m	38.6 %
Invalid Data Time	0 m	0.0 %

Other	total	supine
Oximeter Quality	95.4 %	Good
Flow Quality	100.0 %	Good
RIP Quality	98.1 %	Good
Paradoxical Index	35.9 %	5.3 %
Est. Sleep Efficiency	78.3 %	48.8 %
Respiration Rate	19.1	19.0

Figure 4. Overnight polygraphy report. AHI, apnoea/hypopnoea index; ODI, oxygen desaturation index.

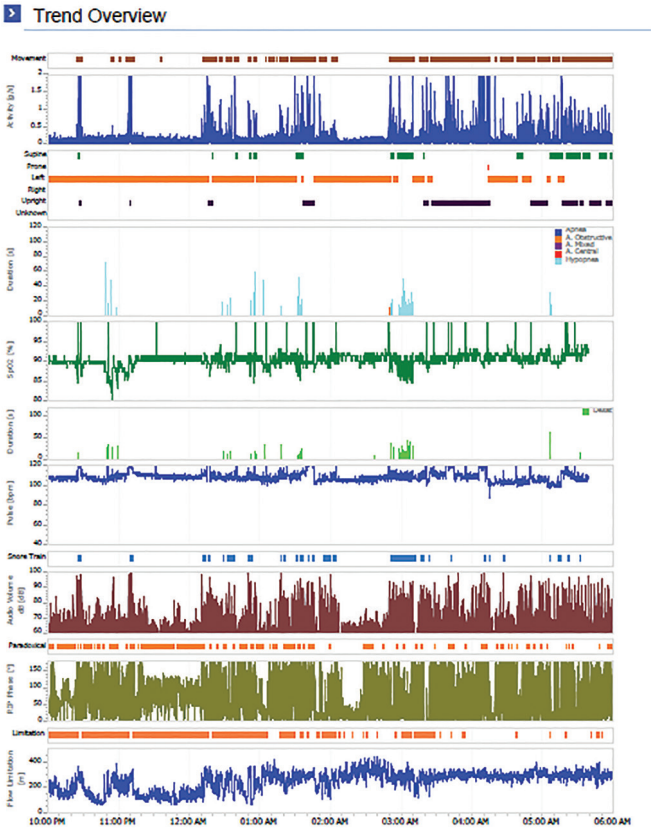


Figure 5. Overnight polygraphy graphs.

The patient was admitted to the Pulmonology Department of the Institute, and oxygen therapy (5–6 L/min) was initiated.

Results of clinical findings

Given the pre-established diagnosis of COPD GOLD stage II (as shown in the patient's medical documents), triple therapy was initiated, according to the latest recommendations: long-acting B2-agonist, inhaled corticosteroid and an inhaled anticholinergic.

Repeated thoracocenteses were performed during hospitalisation. Following consultation with the thoracic surgery specialists, a permanent pleural drainage system was proposed, which the patient refused, mentioning financial and psychological reasons. A respiratory functional test performed during admission showed moderate mixed ventilatory dysfunction.

Given that the patient had symptoms specific to sleep apnoea syndrome (daytime fatigue, lack of concentration, waking up at night with 'gasping for air'), a nocturnal polygraph examination was performed under oxygen therapy (3 L/min), quantifying an apnoea/hypopnoea index (AHI) of 6.1/h; oxygen desaturation index (ODI) = 6.6/h; snore index = 5.4%, average SpO_2 = 90%; lowest SpO_2 = 79%; and time spent with SpO_2 <90% = 22.1% of sleep duration. The mean respiratory rate during the night was 19.1 breaths/min (Figures 4 and 5). The diagnosis of obstructive sleep apnoea syndrome, a mild-symptomatic form, was established.

It was decided to initiate continuous positive airway pressure (CPAP) therapy with 8 cm H_2O pressure (dynamically titrated, with continuous pulse oximetry) with the aim of alveolar recruitment, reduction of inspiratory effort, reduction of apnoeas/hypopnoeas and, implicitly, an increase of haematosis. However, due to the increased expiratory effort, the patient becomes tachypneic (25 breaths/min), which is why CPAP therapy was stopped.

NIV therapy in bi-level positive airway pressure (BPAP) mode was initiated in spontaneous (S) mode, also with continuous monitoring of SpO_2, with pressures adjusted according to the patient's need and comfort as follows: EPAP = 6 cmH_2O; IPAP = 10 cmH_2O. The patient tolerated the ventilation very well, and after a few days, there was noticed an improvement of OSAS-specific symptoms as well as amelioration of dyspnoea.

During hospitalisation, several arterial blood gas (ABG) analyses were carried out, showing a sustained improvement of the blood gases, and finally, the patient accepted the insertion of the permanent pleural drainage system. Discharge

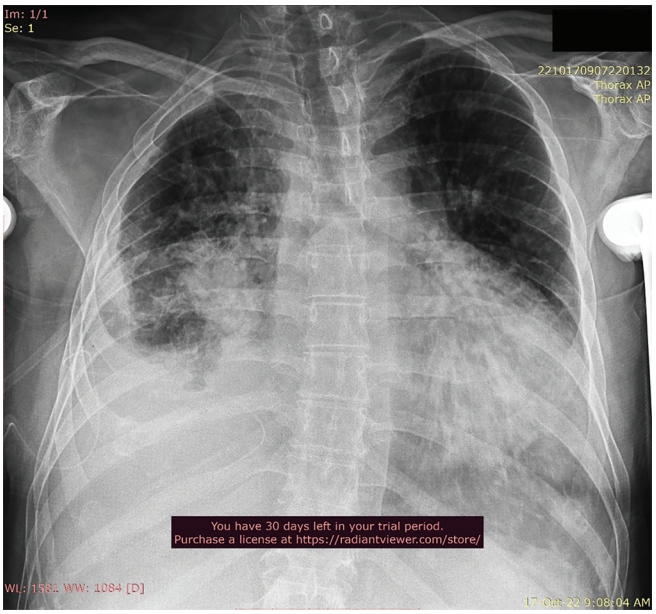


Figure 6. Chest X-ray showing the correct positioning of the drainage tube.

chest X-ray showed a reduction in pleural fluid level in the right hemithorax and correct positioning of the drainage tube (Figure 6).

At discharge, an ABG analysis performed without supplemental oxygen showed PaO_2 = 74.1 mmHg, $PaCO_2$ = 26.9 mmHg and SpO_2 = 95% in room air (Figure 7); the patient was eupnoeic and did not report sleep disturbances, and thus he was recommended to continue NIV in the form of BPAP at home with the same settings from the hospital and to sleep in lateral decubitus. There were also noted 1-point improvements in both the mMRC score (can walk 100 m) and the ECOG score (from 4 – totally bed/wheelchair bound, needs 100% help, to 3 – able to partially care for self; >50% of the time in bed/wheelchair).

Sample type T	Arterial 37.0 °C		
Blood Gas Values			
↑ pH	7.472		[7.350 - 7.450]
↓ pCO_3	26.9	mmHg	[32.0 - 48.0]
↓ pO_3	74.1	mmHg	[83.0 - 108]
Oximetry Values			
↑ ctHb	13.7	g/dL	[4.0 - 10.0]
↓ sO_3	94.6	%	[95.0 - 99.0]
↓ FO_2Hb	93.4	%	[94.0 - 98.0]
↓ FCOHb	0.0	%	[0.5 - 1.5]
FHHb	5.3	%	[-]
FMetHb	1.3	%	[0.0 - 1.5]
Electrolyte Values			
↓ cK^+	3.3	mmol/L	[3.4 - 4.5]
↓ cNa^+	131	mmol/L	[136 - 146]
?↓ cCa^{2+}	1.06	mmol/L	[1.15 - 2.58]
↓ cCl^-	98	mmol/L	[98 - 106]
Metabolite Values			
cGlu	94	mg/dL	[70 - 105]
?↑ cLac	1.9	mmol/L	[0.5 - 1.6]
Temperature Corrected Values			
pH(T)	7.472		
$pCO_3(T)$	26.9	mmHg	
$pO_3(T)$	74.1	mmHg	
Oxygen Status			
ctO_3c	18.0	Vol%	
$p50_c$	26.78	mmHg	
Acid Base Status			
$cBase(Ecf)_c$	-3.7	mmol/L	
$cHCO_3^-(P,st)_c$	22.3	mmol/L	

Figure 7. ABGs before discharge. ABG, arterial blood gas.

Discussion

The literature indicates that NIV therapy has proved superior to oxygen therapy in cancer patients, relieving dyspnoea in patients with hypoxaemic respiratory failure (regardless of $PaCO_2$ level). A 2013 study of 234 patients (1), divided into two groups, NIV or simple oxygen therapy, shows that NIV-treated patients required lower doses of opioids and reported an improved quality of life. As expected, these patients also had improved blood gas parameters, with improvement in dyspnoea and an increased quality of life.

Steindal et al. (2) call NIV the 'gold standard' for inpatients with COPD exacerbations, which is also applicable to our case. Often, COPD exacerbations involve mucus hypersecretion, which causes atelectasis of the peripheral respiratory territory with air-trapping phenomena, inevitably leading to hypoxemia and hypercapnia. Also of note is the risk of infection of stagnant mucus in the bronchial tree (3). In the present case, the neoplastic pathology that the patient presented resembles an exacerbation of already existing COPD, through the additional obstruction that the adenopathic blockage produces and the hypersecretion of mucus, as well as through the immunosuppressed status of the oncology patient that constantly puts him at risk of infection. Thus, BPAP therapy decreases respiratory effort in these patients, ventilates collapsed airspaces and mobilises secretions (4,5).

The results of the meta-analysis by Wilson et al. (6) indicate a clear benefit of using home NIV in patients with COPD,

compared to no action taken or even to oxygen therapy by itself, in terms of decreases in the mortality, risk of readmission to a hospital unit, and tracheal intubation. However, the authors did not identify a measurable increase in the quality of life in these patients.

A study of palliative patients in the intensive care unit assesses the usefulness of NIV in the reduction of dyspnoea and pain (by reducing morphine requirements). However, 76% of patients included in the study reported sleep disruptions, and 10% requested discontinuation of therapy (7,8).

When using NIV, patient feedback should always be taken into account, especially if the aim of therapy is palliative. Adjustment of pressures and machine functions in dynamics and in relation to respiratory parameters (clinical – respiratory rate, use of accessory muscles, the difficulty of inspiration–expiration movements, xerostomia; paraclinical – arterial blood gases, respiratory function tests, nocturnal polygraphy, polysomnography) is the standard to be followed by medical staff when initiating such therapies.

The particularity of the case is the association between sleep apnoea syndrome and ventilatory dysfunction caused by COPD overlapping lung cancer. The incompatibility between the needs of the patient and CPAP therapy delivering a single pressure, which the patient found difficult to exhale against, led to the use of BPAP and thus to the improvement of the symptoms of hypoxemic respiratory failure and poor sleeping quality.

Conclusions

The patient's evolution was favourable, with improvement in dyspnoea, performance status and sleep quality. It is important to note that NIV therapy is not easy to tolerate and, therefore, a good understanding of what is about to happen to the patient is required. Monitoring the patient and obtaining feedback is at least as important as the therapy itself. Adjusting the machine settings and titrating pressures dynamically eases the burdens of ventilation and the underlying disease, and leads to satisfactory results in a shorter time. Thus, the importance of using NIV therapy in cancer patients is highlighted by its palliative role in increasing the quality of life and restoring respiratory comfort.

Funding

None.

Conflicts of Interest

The authors declare no conflict of interest.

Institutional Review Board Statement

Not applicable.

Informed Consent statement

Informed consent was obtained from all subjects involved in the study.

Data availability statement

Data used to support the findings of this study are available from the corresponding author upon request.

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