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Prophylactic use of non-invasive mechanical ventilation in lung resection

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Abstract. – OBJECTIVE: To evaluate if the prophylactic application of BiPAP previous to lung resection and 17 hours postoperatively improves respiratory function. In order to do this, we studied the results of arterial blood gases and portable spirometry in the immediate postoperative period and at the first and third postoperative day. Secondary objectives included evaluating whether this same pattern decreases the incidence of postoperative pulmonary complications (PPC) and hospital stay.

PATIENTS AND METHODS: This was a prospective, randomized clinical study. Between January 2012 and June 2013, 50 patients who had undergone lung resection with posterolateral thoracotomy were assigned to one of two groups by a random number generator according to whether or not they would receive prophylactic BiPAP pre- and postoperatively.

RESULTS: The results of the gasometric and spirometric values were similar in both groups. There were no statistically significant differences ($p > 0.05$). There was not a decrease in the incidence of PPC in the group that received prophylactic BiPAP. Likewise, postoperative stay was similar in both groups. The BiPAP group was 6.60 ± 4 days and the non BiPAP group was 6.84 ± 3.94 days (p = 0.63).

CONCLUSIONS: One drawback of this work was the limited number of hours that BiPAP was employed, and when compared to other studies, the application of low-pressure support. We did not find any significant differences between using prophylactic BiPAP or not, suggesting that such treatment should not be performed indiscriminately. More investigations are needed with a larger number of patients in order to better evaluate the possible benefits of using prophylactic BiPAP in thoracic surgery.

Key Words
Noninvasive ventilation, BiPAP, Thoracic surgery, Gas exchange, Prophylactic noninvasive ventilation.

Introduction

The occurrence of postoperative pulmonary complications (PPC) after lung resection surgery (LRS) ranges between 19-59%, a very high rate if it is compared to upper abdominal surgery (16-20%) or lower abdominal surgery (5%)[1,2]. These complications, especially atelectasis, retained secretions, pneumonia, and respiratory failure, contribute significantly to postoperative mortality because they can evolve into acute lung injury (ALI) and acute respiratory distress syndrome (ARDS)[1,3,4].

Lung resection usually produces pulmonary dysfunction that can last for several days after the intervention. The causes are altered ventilatory function due to reflex inhibition of the phrenic nerve, effects of general anesthesia, postoperative thoracic pain, collapse of the distal airways, and the loss of functional parenchyma. It has been suggested that prior chemotherapy and low values of predicted postoperative carbon monoxide diffusion ($DLCO_{ppo}$) increase the risk of PPC[5].

Non-invasive mechanical ventilation (NIMV) has demonstrated to be useful in the treatment of acute hypoxemic and hypercapnic respiratory failure (ARF)[6,7]. It allows to the respiratory

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and diaphragm muscles to rest, reduces muscle fatigue, decreases hypercapnia, increases oxygenation, improves the relationship between ventilation and perfusion, and decreases the sensation of dyspnea. Its postoperative prophylactic use improves oxygenation in non-hypercapnic patients[8-10], although the benefits that would allow a systematic application have not been clearly demonstrated. The primary endpoint of this study was to evaluate whether or not prophylactic application of BiPAP before lung resection and 17 hours following surgery improves respiratory function. The secondary endpoints included evaluating whether this same pattern decreases the incidence of PPC and hospital stay.

Patients and Methods

Patients

A prospective, randomized study was carried out on 50 patients who had undergone elective lung resection (segmentectomy, lobectomy or pneumonectomy) by posterolateral thoracotomy for lung cancer, lung metastasis and bronchiectasis surgery. Data were collected from January 2012 to June 2013 and patients were assigned to the groups by a random number generator. The two groups were divided according to whether or not they received prophylactic BiPAP. All patients over 18 programmed for LRS were included after having been informed both verbally and in written form. Then, they signed an informed consent to participate in the research.

Exclusion criteria were: incisions other than thoracotomy, minor lung resections such as biopsies or bulla resections, exploratory thoracotomies (without resection of lung parenchyma), previous use of domiciliary NIMV, body mass index ≥ 35%, diagnosed obstructive sleep apnea (OSA), neuromuscular and/or thoracic cavity disease, tracheostomy patients, and those who refused to participate in the study.

Study Methodology

Preoperative period

All patients received respiratory rehabilitation 2 weeks before the intervention. They were instructed on directed ventilation and improvement of thoracic cavity expansion through shoulder flexion and abduction, both seated as well as lateral and supine decubitus. Various techniques for an efficient cough and use of the spirometer Spiro Ball® (Global Healthcare, Little Chalfont, UK) were employed so patients could efficiently mobilize volumes of air. Exercises for main muscle groups of the upper limbs and cycloergometers (Proaction BH Fitness and Proaction magnetic) for the lower limbs were also used. After the treatment session, and according to the random assignment of the patients, the BiPAP group received 1 hour daily treatments with a facial mask (IPAP 10-12 cmH_2O, EPAP 4-5 cmH_2O) with a fraction of inspired oxygen 0.21 (FiO_2) one week before surgery, applied by the rehabilitation specialist responsible for each patient.

In all cases regardless of the study of the disease that motivated the surgery, spirometry at baseline Viasys Healthcare® (Cardinal Health Dublin, OH, USA) and Jaeger MasterScreen Body® (Yorba Linda, CA, USA) were performed, and arterial blood gas (gasometer ABL77® series by Radiometer Copenhagen, Copenhagen, Denmark), analyses (blood count, biochemistry and coagulation), x-ray and thoracic CT, were carried out. Patients with obstructive spirometry pattern were treated with bronchodilators.

Intraoperative Period

All patients were operated on by selective intubation with a double-lumen tube Mallinckrodt™ (Covidien, St. Louis, MO, USA), left or right, depending on which hemithorax was to be operated on. In those patients whom for anatomical reasons was not possible to place it, an endotracheal tube was used with a bronchial blocker Coopdech® (Daiken Medical Co., Tokyo, Japan).

The patients were monitored with the Primus Infinity C700® anesthetic work station by Dräger (Lubecca, Germany). The recorded hemodynamic parameters were electrocardiogram, heart rate (HR), non-invasive blood pressure and pulse oximetry (SpO_2). Respiratory parameters were respiratory rate (RR), FiO_2, end tidal CO_2 ($ETCO_2$), tidal volume, minute volume, peak inspiratory pressure, plateau pressure and PEEP. Depth anesthesia was also measured (BIS VISTA® Aspect Medical Systems, Norwood, MA, USA). After induction, the radial artery was accessed to measure invasive blood pressure and to analyze blood gasses. A subclavian vein was also cannulated. Unless contraindicated, a thoracic epidural catheter was placed at level T6-T7 or T7-T8 (set for combined anesthesia CS Escure 27G/18G, Smiths Medical®, Minneapolis, MN, USA).

The anesthetics administered were propofol, remifentanil and cisatracurium. During the intraoperative period, the bipulmonary ventilation was maintained until the opening of the chest, at which point a one-lung ventilation was started using the following parameters: tidal volume 6 ml/kg, RR 15-16 min^{-1}, PEEP 5-8 cmH_2O and FiO_2 100%. As for $ETCO_2$, a light hypercapnia was permitted ($ETCO_2$ up to 50 torr). Once the resection was done, after checking for the absence of air leaks in the lung and before closing the chest, bipulmonary ventilation was re-initiated.

At the end of the intervention, after reversal of neuromuscular block and extubation, the patients were admitted to the postsurgical Critical Care Unit. They were monitored, and a facemask was inserted (dual system adult Venturi mask, Cardinal Health, Dublin, OH, USA) with FiO_2 40%. The BiPAP group was treated with BiPAP VISION from Respironics® (Murrysville, PA, USA) with an IPAP 10-12 cmH_2O and an EPAP 4-5 cmH_2O, administered for 30 min every 2 h until 24:00. Later, during the night, it was administered only once from 4:00 to 4:30 am. After this last session, treatment with BiPAP was terminated. Epidural analgesia was done with fentanyl 3 µg/ml + bupivacaine 0.1% and intravenous metamizol 2 g/8 h. In all cases, initiated and trained respiratory physiotherapy in the pre-operative phase was continued.

Data Collection

Data collected prior to anesthesia induction

- Demographic characteristics of the patient: age and sex.
- Anthropometric variables: height, weight, body mass (BMI), ASA anesthesia risk scale. Previous smoking or tobacco use (daily quantity, how long non-smoking or if patient was a non-smoker at the time of the surgery).
- Respiratory pathology background (COPD, bronchial asthma, emphysema, previous lung resection surgery).
- Cardiac pathology background (hypertension, cardiac arrhythmias and type, angina, myocardial infarction, diabetes mellitus).
- Baseline spirometry: FEV_1, FEV_1%, FVC, FVC%, and FEV_1/FVC. Room air arterial blood gas: pH, PaO_2, $PaCO_2$, and HCO_3^-. Depending on the patient's situation, other pre-operative tests such as CO_2 diffusion and a test for maximum oxygen consumption (VO_{2max}) were performed.
- Imaging: chest X-ray, chest CT (size and number of nodules, presence of mediastinal lymph node involvement) and positron emission tomography (PET) or cranial CT.

Data collected in the intraoperative period

Type of lung resection: segmentectomy, lobectomy, pneumonectomy. Intraoperative blood gas data (pH, PaO_2, $PaCO_2$), blood pressure, HR, RR, SpO_2. These data were collected: 30 min after intubation (bipulmonary ventilation), 30 min after one-lung ventilation and 30 min after starting bi-pulmonary ventilation again.

Data collected in the postoperative period

- In the immediate postoperative period: blood count, coagulation tests (Quick´s index, rT-TPA), biochemical (creatinine, urea, sodium, potassium), arterial blood gases (pH, $PaCO_2$, PaO_2), chest x-ray (atelectasis, pneumothorax), pain measurement (visual analogue scale – VAS), blood pressure, HR, RR, SpO_2.
- Data collected on the first postoperative day: arterial blood gases (pH, $PaCO_2$, PaO_2), chest x-ray (atelectasis, lung infiltration, pneumothorax), spirometry (FEV_1, FEV_1%, FVC, FV% and FEV_1/FVC).
- Data collected at 72 h postoperatively: arterial blood gases (pH, $PaCO_2$, PaO_2), x-ray of the thorax (atelectasis, lung infiltration, pneumothorax), spirometry (FEV_1, FEV_1%, FVC, FV% and FEV_1/FVC), clinical data (cough, sputum, recent onset of fever).

Statistical Analysis

The sample size was composed of 50 patients divided into 2 groups of 25. They constituted the total of consecutive patients, candidates for the above-mentioned surgery and who met the criteria for inclusion in a period of 18 months. The sample poses no handicap since relevant studies in this field[8,11] show a relatively restricted variability or statistical variance in regards to the parameters recorded in this work. A sampling error and confidence level of 0.05 was considered.

SPSS 20 statistical software (IBM, Armonk, NY, USA) for MAC was employed. For the descriptive analysis of quantitative variables, frequency distribution, mean, median, variance and standard deviation were used. To analyze the differences in variables between the two groups, the Mann-Whitney U test was done. Given the sample size, the Z Kolmogorov-Smirnoff test was conducted to assess whether these variables

followed a normal distribution. For those variables that had an approximate normal distribution behavior, the differences between groups were analyzed with the *t*-test. Distribution of proportions was used in the descriptive analysis of qualitative variables. The comparison between groups was performed using statistical x^2-test. The accepted level of significance was <0.05.

Results

On 61 patients included at the beginning of the study, a total of 50 were included, having excluded 11 previous to randomization: 2 for previous tracheostomies, 5 for home NIMV, and 4 for suffering from OSA. The baseline characteristics are listed in Table I. The results of spirometric values and blood gas analyses are shown in Tables II and III, and radiographic findings in Table IV. The type of surgery performed is reflected in Table V.

Preoperatively in the BIPAP group, 28% of the patients had normal spirometry, 8% had an obstructive pattern, and 68% a restrictive pattern following the SEPAR guidelines of 2013[12]. In the non BIPAP group, 36% presented a normal spirometry, 4% an obstructive pattern and 56% a restrictive pattern (p = 0.672).

Preoperative hypercapnia ($PaCO_2$ > 45 mmHg) was presented in 8% of the patients in the BIPAP group as well as 16% in the non BIPAP group (p = 0.329).

Table I. Baseline characteristics of patients.

			BIPAP group (n = 25)	Non BIPAP group (n = 25)	*p*-value
Age* (years)			60.08 ± 10.68	58.52 ± 9.51	0.426
BMI* (kg/m^2)			26.67 ± 5.14	26.77 ± 4.29	0.892
Sex** (male/female)			52% (13)/48% (12)	76% (19)/24% (6)	0.077
ASA					**0,651**
II**			16% (4)	24% (6)	
III**			76% (19)	64% (16)	
IV**			8% (2)	12% (3)	
Smokers type					
Previous tobacco habits**	Si		76% (19)	80% (20)	0.733
	No		24% (6)	20% (5)	
Active smoker**	Si		24% (6)	8% (2)	0.123
		<1 pack/day	50% (3)	0% (0)	
		1-2 packs/day	33.3% (2)	100% (2)	
		>2 packs/day	16.7% (1)	0% (0)	
	No		76% (19)	92% (23)	
Patients comorbidities					
Respiratory*			(n = 8)	(n = 14)	0.891
COPD			62.5% (5)	42.9% (6)	
Asthma			12.5% (1)	42.3% (2)	
Pulmonary emphysema			12.5% (1)	14.3% (2)	
Bronchiectasis			0% (0)	7.1% (1)	
Tuberculosis			0% (0)	7.1% (1)	
Spontaneous pneumothorax			12.5% (1)	7.1% (1)	
Cardiovascular*			(n =15)	(n = 11)	0.102
High blood pressure			100% (15)	81.8% (9)	
Arrythmias (atrial fibrillation)			0% (0)	18.2% (2)	
Duration of surgical intervention** (hours)			3.76 ± 1.26	3.8 ± 1.12	0.825
Hospital stay** (days)			6.60 ± 4	6.84 ± 3.94	0.63

Data expressed in: *average ± standard deviation. **Percentages, and in parentheses, number of patients in each group.

Table II. Spirometric values.

	BIPAP group (n = 25)	Non BIPAP group (n = 25)	*p*-value
Preoperative values			
FEV_1 (liter)	2.06 ± 0.65	2.21 ± 0.77	0.503
FEV_1 (%)	71.48 ± 18.27	67.90 ± 19.03	0.56
FVC (liter)	2.91 ± 0.82	2.93 ± 0.89	1.0
FVC (%)	72.64 ± 13.72	70.61 ± 16.17	0.648
FEV1/FVC	71.04 ± 12.69	73.13 ± 12.17	0.734
First postoperative day values			
FEV_1 (liter)	1.03 ± 0.51	1.05 ± 0.40	0.415
FEV_1 (%)	34.36 ± 14.44	33.20 ± 10.51	0.662
FVC (liter)	1.44 ± 0.80	1.42 ± 0.59	0.752
FVC (%)	34.84 ± 12.01	33.60 ± 10.42	0.977
FEV_1/FVC	72.53 ± 14.63	74.04 ± 12.26	0.662
72 hours postoperative values			
FEV_1 (liter)	1.06 ± 0.37	1.20 ± 0.49	0.215
FEV_1 (%)	36.64 ± 11.29	37.71 ± 13.34	0.515
FVC (liter)	1.44 ± 0.45	1.60 ± 0.59	0.405
FVC (%)	37.52 ± 10.15	37.33 ± 12.12	0.772
FEV_1/FVC	72.27 ± 15.47	74.76 ± 10.26	0.660

Data expressed in: average ± standard deviation.

Cancer was the indication for surgery in 92% of the patients in both groups, the remaining 8% was due to other pathologies. One patient from each group presented with bronchiectasis and one from each group presented with residual necrotizing granulomatous inflammation.

Patients with bronchiectasis received antibiotic treatment for *Ps. aeruginosa* several times previous to surgery. They were not under treatment with antibiotics as the time of the surgery because they were free from respiratory symptoms. After surgery, none received systemic antibiotic or corticoid treatment. All patients received 500 mg of nebulized ipratropium bromide diluted in 3 ml of saline every 8 h for the first 3 days postoperatively.

In general, there were few complications. There were no significant differences between the groups ($p > 0.05$). The most frequent was atelectasis, present in 24% of patients (6 in each group), followed by hypotension requiring vasoactive drugs in 8% (3 from BIPAP group and 1 from non BIPAP group), and persistent air leak

Table III. Arterial blood gas values.

	BIPAP group (n = 25)	Non BIPAP group (n = 25)	*p*-value
Preoperative values			
pH	7.38 ± 0.4	7.36 ± 0.5	0.316
PaO_2 torr (kPa)	106 ± 25 (14 ± 3.5)	104 ± 28 (13.9 ± 3.8)	0.801
$PaCO_2$ torr (kPa)	41 ± 4.5 (5.47 ±0.6)	42 ± 4 (5.8 ± 0.5)	0.547
Immediate postoperative values			
pH	7.35 ± 0.2	7.34 ± 0.03	0.718
PaO_2 torr (kPa)	133 ± 41 (17.8 ± 5.5)	155 ± 40 (20.7 ± 5.3)	0.095
$PaCO_2$ torr (kPa)	44 ± 9 (5.9 ± 1.3)	44 ± 5 (5.9 ± 0.6)	0.884
First postoperative day values			
pH	7.37 ± 0.03	7.37 ± 0.04	0.815
PaO_2 torr (kPa)	132 ± 39 (17.7 ± 5.2)	128 ± 41 (17 ± 5.4)	0.655
$PaCO_2$ torr (kPa)	43 ± 6 (5.7 ± 0.8)	42 ± 6 (5.6 ± 0.8)	0.838
72 hour postoperative values			
pH	7.40 ± 0.046	7.40 ± 0.040	0.748
PaO_2 torr (kPa)	84 ± 26 (11.2 ± 3.4)	94 ± 33 (12.6 ± 4.4)	0.415
$PaCO_2$ torr (kPa)	42 ± 12 (5.6 ± 1.6)	40 ± 5 (5.4 ± 0.6)	0.810

Data expressed in average ± standard deviation.

Table IV. X-ray findings.

	Preoperative period		Immediate postoperative		1st day postoperative		3rd day postoperative	
	BIPAP (n=25)	Non BIPAP (n=25)	BIPAP (n=25)	Non BIPAP (n=25)	BIPAP (n=25)	Non BIPAP (n=25)	BIPAP (n=25)	Non BIPAP (n=25)
Normal	12% (3)	16% (4)	72% (18)	64% (16)	72% (18)	52% (13)	56% (14)	56% (14)
Alveolar condensation	8% (2)	4% (1)	4% (1)	4% (1)	4% (1)	8% (2)	8% (2)	8% (2)
Pulmonary nodule	44% (11)	40% (10)	–	–	–	–	–	–
Pulmonary emphysema	0% (0)	4% (1)	4% (1)	4% (1)	4% (1)	0% (0)	4% (1)	0% (0)
Lung infiltration	12% (3)	0% (0)	4% (1)	0% (0)	4% (1)	4% (1)	4% (1)	0% (0)
Atelectasis	4% (1)	0% (0)	8% (2)	20% (5)	12% (3)	20% (5)	16% (4)	20% (5)
Cystic cavity	4% (1)	4% (1)	–	–	–	–	–	–
Hilar mass	0% (0)	4% (1)	–	–	–	–	–	–
Collapsed and damaged lung	0% (0)	4% (1)	–	–	–	–	–	–
Pulmonary mass	16% (4)	24% (6)	–	–	–	–	–	–
Pleural effusion	–	–	4% (1)	8% (2)	4% (1)	8% (2)	8% (2)	12% (3)
Hemothorax	–	–	4% (1)	0% (0)	-	-	-	-
Pneumothorax	–	–	–	–	0% (0)	4% (1)	4% (1)	0% (0)
Pleural effusion + atelectasis	–	–	–	–	0% (0)	4% (0)	–	–
Alveolar condensation + atelectasis	–	–	–	–	–	–	0% (0)	4% (1)
p-value	0.542		0.712		0.663		0.743	

Data expressed in percentages, and in parentheses, number of patients in each group.

at 6% (3 patients in the BiPAP group). The postoperative hospital stay was similar in both groups. The BiPAP group stayed 6.60 ± 4 days and the non BiPAP group stayed 6.84 ± 3.94 days ($p = 0.63$).

Discussion

Effects on Pulmonary Function and Blood Gas Analysis

We analyzed the differences between either using or not using prophylactic BiPAP on LRS patients. Examination of the results of blood gas analysis and spirometry showed no significant differences between groups at any of the times they were recorded. After surgery, a significant decline in FVC and FEV_1 was detected, which improved after the third day. As for the values of blood gases in the BiPAP group, both immediately and after the first day, the $PaCO_2$ remained similar to preoperative values, decreasing at the third day. In the non BiPAP group, PaO_2 was higher than the preoperative values, also decreasing on the third postoperative day. As for the $PaCO_2$, it increased immediately after surgery and the first postoperative day and then decreased

Table V. Type of surgery.

	BIPAP group (n = 25)	Non BIPAP group (n = 25)	*p*-value
Current intervention	–	–	0.98
Segmentectomy	28% (7)	24% (6)	–
Lobectomy	48% (12)	56 % (14)	–
Right pneumonectomy	8% (2)	8% (2)	–
Left pneumonectomy	4% (1)	4% (1)	–
Bilobectomy	12% (3)	8% (2)	–

Data expressed in percentages, and in parentheses, number of patients in each group.

in both groups. These data were not statistically significant. These results are different from those obtained in the majority of studies, in which an improvement in blood gas and spirometric values were obtained with the application of prophylactic BiPAP. This is probably due to a higher number of treatment hours, and because the patients had worse spirometry data[11]. In addition, a higher-pressure support was used in those studies. In our study, we used a postoperative IPAP of 10-12 cmH_2O and an EPAP of 4-5 cmH_2O, creating a pressure support (PS) of 6-7 cmH_2O. Other authors used an IPAP 12.6 ± 1.2 cmH_2O and an EPAP 2.9 ± 0.7 cmH_2O, generating a PS of 9.7 cmH_2O.

Joris et al[9] noticed a "dose-dependent effect" of inspiratory support in postoperative patients with restrictive syndrome, which was confirmed in a prospective study of 33 obese patients undergoing gastroplasty. These results differ from ours, which, regardless of the group, showed no difference in improvement of pulmonary function. This could be explained by the fact that we used a lower pressure support and a shorter BiPAP total treatment time, and that we had an older patient sample in our investigation (33.4 ± 12.3 years in Joris et al[9], and 60.08 ± 10.68 years in ours).

In our sample smokers predominate, with 76% of BiPAP group and 80% of non BiPAP, while the Joris et al[9] study had only 30%. Our results also differed from a research done by Aguiló et al[8], whose results were completely different due, probably, to a longer total treatment with BiPAP and a higher PS. While most published papers have shown positive results in blood gas and pulmonary function with NIMV, there are also other studies that show the opposite. This variability of observed results could be due to several factors, including different characteristics of the type of surgery, heterogeneity and sample size, use of CPAP or BiPAP, whether it was used as a prophylactic or a therapeutic measure, and duration of respiratory therapy.

In a recently completed prospective, controlled study (13) with 50 patients operated on with videothoracoscopy (lung resections, esophagectomies, and surgery for pericardial cysts), it was assessed whether postoperative application of prophylactic BiPAP (IPAP 13 ± 3.2 cmH_2O, EPAP 4 cmH_2O) as opposed to conventional treatment with respiratory physiotherapy improved both lung expansion and function and decreased incidences of PPC. BiPAP was applied a total of 13.5 ± 4.9 h during the first three days after surgery. No statistically significant differences were found between the groups regarding spirometric values ($p < 0.05$). Chest CT showed evidence of improved lung expansion a week after intervention in the group that received BiPAP ($p = 0.015$). However, these image findings were not reflected in a better clinical outcome for the patients.

These findings are consistent with ours. Nevertheless, the studies cannot be compared. The other study was done on patients who had undergone surgery with videothoracoscopy and ours with posterolateral thoracotomy, and included different types of surgery, from bulla resection to surgery for lung tumors. Moreover, they employed BiPAP for a longer period of time than ours with a higher PS.

Analysis of the Effect of Prophylactic BiPAP Therapy on Postoperative Pulmonary Complications and Postoperative Hospital Stay

In our investigation, as in others[11,13-16], a lower incidence of PPC was not observed with prophylactic treatment using NIMV. There are, however, other researches, which have demonstrated a decrease in PPC. It should be considered that there were different circumstances in different studies, such as the type of surgery: cardiac[17], abdominal[18] and aortic[19,20].

As for the possible reduction in hospital stay, our results are comparable to those obtained by Ebeo et al[21], an investigation of obese patients, in which it was found that although NIMV improves pulmonary function, it does not mean that it decreases hospital stay. Perrin et al[11] have found a significant decrease in hospital stay after using BiPAP in pulmonary resection. Similar results were also found in studies on aortic surgery[19,20], but not in gastric surgery, which can have postoperative problems that delay discharge. In patients who have undergone lung surgery, the prevention or resolution of PPCs is one of the main factors in reducing hospital stay.

Current Studies

Given the discrepancies and the small number of patients included in most of the series, it is important to include a greater number of patients. A study is already underway with a randomized design and estimated sample size of 300 patients[22]. This work could answer to many questions, which still remain unresolved.

Study Limitations

Our study has some limitations regardless of the small sample size. The first is the low number of hours was employed when compared to other studies. We also used a lower PS than the majority of publications. Another important limiting factor is the good respiratory function that the majority of the patients included in our study had previously, and the low incidence of clinically significant postoperative complications, compared to other analyses. In general, prevalence of PPC is 30%[23]. In our study, the most frequent PPC was atelectasis, present in 24% of the patients.

Conclusions

We did not find significant differences between using or not using prophylactic BiPAP, which suggests that this type of treatment should not be used indiscriminately. More studies are necessary with a larger sample size to better evaluate the possible benefits of using prophylactic BiPAP in thoracic surgery.

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Conflict of Interest

The Authors declare that they have no conflict of interests.

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