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Total hip arthroplasty and chronic obstructive pulmonary disease in a high dependency unit

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Abstract
Patients with chronic obstructive pulmonary disease (COPD) undergoing lower limb arthroplasty present an increased risk for intra- and postoperative respiratory complications. The aim of our study is to determine disturbances in arterial blood gases (ABGs) that might occur during and after total hip arthroplasty (THA) procedure in a high dependency unit (HDU). We present the cases of 23 patients with a mean age 71±2 years, grouped in class II and III, according to ASA Physical Status Classification System, who underwent THA under epidural anesthesia. Our study reveals that in the case of patients with COPD who underwent THA, reduction of pO2 was statistically important during and immediately after the surgical intervention, while an important concurrent change of pH and pCO2 was not observed. For a better outcome in patients with COPD who undergo THA, both intra- and postoperative respiratory care in the HDU, with hemodynamic monitoring and avoidance of hypotension and hypoxemia, are essential.

Keywords: THA, COPD, post-operative management

1. Introduction
COPD is a serious chronic disease which limits the activities of individuals and, among others, directly influences respiratory functions during any type of surgery [1]. It is well-known that patients with COPD represent a high risk group for intraoperative and postoperative respiratory complications and therefore require close monitoring and special treatment [2]. They typically record increased hospitalization days but also increased morbidity and mortality rates. The most frequent complications recorded in the literature are atelectasis (20-69%) and postoperative pneumonia (9-40%) [2, 3]. These complications are related to age, the type of surgery and the type of anesthesia.
The aim of our study was to investigate the intraoperative and postoperative changes in ABGs in patients with COPD undergoing THA and hospitalized in a HDU.

2. Methods and Results
We investigated 23 patients with COPD, with a mean age of 71±2 years and included in class II and III, according to ASA Physical Status Classification System (Table 1) who underwent THA and were postoperatively hospitalized in a HDU.

Table 1: ASA Physical Status Classification System

ASA PS Classification	Definition
ASA I	A normal healthy patient
ASA II	A patient with mild systemic disease
ASA III	A patient with severe systemic disease
ASA IV	A patient with severe systemic disease that is a constant threat to life
ASA V	A moribund patient who is not expected to survive without the operation
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes

Epidural anesthesia with 10ml of 2% xylocaine was applied to all patients through epidural catheter. The epidural catheter was kept for postoperative administration of analgesia with 3ml of bupivacaine 0.25% in 3 ml saline water.

The monitoring of patients' respiratory function included physical examination, breaths and blood pressure measurement, pulse oximetry and analysis of arterial blood samples before, during and 2 hours after surgery. All patients received oxygen through Venturi mask, in accordance with their clinical condition and preoperative assessment.

Concerning the levels of ABGs, the observed change of pO2 was statistically significant, particularly during surgery, and one hour thereafter, while an important concurrent change of pH and pCO2 was not observed (Table 2).

Table 2: Results

	Before Surgery	During Surgery	2 Hours After Surgery
PO2	75±10.40	64±10.34*	85±10.55*
PH	7.38±0.2**	7.39±0.2**	7.40±0.15**
pCO2	43±2**	45±1**	41±1.5**

* Statistically significant $p<0.05$

** Statistically non significant $p>0.05$

3. Discussion

Predisposing factors for developing complications of the respiratory system are the advanced age, obesity, malignancy existence, neurologic image, immune status, patients' health status according to ASA Physical Status Classification System (>2), smoking, the type of surgical intervention, the type and duration of anesthesia and the period of hospitalization.

Particularly in the case of patients with respiratory dysfunction, as it is the case for our patients, these factors were seriously taken into account. More so, preoperative assessment of pulmonary function and ABGs helped to a better treatment and avoidance of complications during hospitalization. Furthermore, the pre-operative administration of inhaled β2 stimulants (salbutamol or fenoterol), in combination with inhaled corticosteroids (beclomethasone), contributed to better preparation of patients before surgery.

The observed change of pO2m which was statistically significant during surgery and one hour thereafter, may be attributed to an input of microemboli in the pulmonary circulation from the bone marrow, during riveting, due to the increased intramedullary pressure [4, 5]. Increased intramedullary pressure greater than 150 mmHg (50mmHg as a normal value) increases by 10 times the probability of microemboli fat development. Studies show that 1gr of lung microemboli causes a big drop of pO2 level, while 2gr cause immeasurable change and serious hypoxemia [6].

Studies have shown that these microemboli, besides fat, contain other components of bone marrow, such as tissue thromboplastin, which, in combination with mechanical blockage of circulation, causes vasoconstriction [7]. Vasoconstriction and obstruction increase the mean pulmonary artery pressure and the intrapulmonary shunt, due to diversion of blood flow, thereby reducing the pO2. The above mechanism is considered likely to be able to explain the occurrence of hypoxia in patients undergoing lower limb arthroplasty [8, 9].

It has also been found that elderly patients with COPD - because of preexisting disturbance in ventilation/perfusion ratio (VA/Q) or/and because of heart disease coexistence- possibly exhibit significant cardiopulmonary dysfunction, even with a minimum of microemboli present in the pulmonary circulation during the above surgical operations. More so, the site on which patients are placed during surgery (lateral position), especially in the case of those suffering from COPD, contributes to a further disturbance of VA/Q ratio, resulting in more severe hypoxia [6, 10]. Thus, the surgical technique applied was the least consuming in terms of duration [11].

Statistically significant observed hypoxemia during and immediately after surgery and the gradual recovery 2 hours after, confirms our insistence on taking all the necessary measures for accurate preoperative assessment, prevention and avoidance of complications.

The ASA Physical Status Classification System proved to be an important tool while deciding for the surgery of our patients with COPD. Planning and execution of anesthesia, the choice of drugs, as well as strict observance of smoking quitting eight weeks before surgery were cornerstones that support the entire treatment of our patients, resulting in a good outcome.

In order to complement the intraoperative vital capacity maneuvers, various techniques of respiratory physiotherapy such as incentive spirometry, deep breathing exercises, diaphragmatic breathing, intermittent positive-pressure breathing, continuous positive airway pressure (CPAP) or non-invasive positive pressure ventilation (NIPPV) are currently applied to prevent the postoperative fall in functional lung volume and/or to re-open atelectatic areas [12].

In our case, measures for improvement of hypoxemia after surgery included: elevated position, oxygen therapy, administration of bronchodilators via nebulizer (β2 stimulants, ipratropium bromide), adequate postoperative analgesia, maintenance of stable hemodynamic status, accurate physiotherapy and early mobilization.

4. Conclusion

In conclusion, patients with COPD represent a high risk group for lower limb arthroplasty because of pre-existing disorders of the respiratory function. Epidural anesthesia in such patients has proved beneficial while preoperative check-up of the respiratory system is necessary in order to prevent and avoid complications.

The intraoperative care with respiratory and hemodynamic monitoring as well as postoperative care in the ICU with continuous monitoring of arterial blood saturation, measurement of ABGs, maintenance of stable hemodynamic status and avoidance of hypotension and hypoxemia through appropriate measures, is essential for a better outcome in the case of patients with COPD after lower limb arthroplasty.

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6. References

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