



## ORIGINALES

### **Exploratory laparotomy and cholecystectomy: analysis of respiratory rate and oxygen saturation of patients in the immediate postoperative period**

Laparotomia exploratória e colecistectomia: análise da frequência respiratória e saturação de oxigênio de pacientes no pós-operatório imediato

Laparotomía exploratoria y colecistectomía: análisis de la frecuencia respiratoria y saturación de oxígeno de los pacientes en el postoperatorio inmediato

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#### **ABSTRACT:**

**Objective:** To evaluate and compare the respiratory rate and oxygen saturation of patients in the immediate postoperative period of exploratory laparotomy and cholecystectomy.

**Material and Method:** This is a cross-sectional and quantitative study with 63 patients seen between November 2014 and April 2015. Data were collected through a structured questionnaire applied to patients admitted to the Surgical Clinic of the Municipal Hospital of Imperatriz City. Patients of both sexes, aged from 18 to 59 years, in the immediate postoperative period of exploratory laparotomy (Group I) and cholecystectomy (Group II) participated in the study. Data related to respiratory rate (RR) and oxygen saturation (SpO<sub>2</sub>) were extracted from the questionnaire. Data were analyzed statistically using the BioEstat 5.0 program, as well as Shapiro Wilk test for normality between variables, Mann-Whitney inferential analytical test, and Spearman test for correlation between variables.

**Results:** There was no statistical significance regarding the clinical changes of RR ( $p = 0.4$ ) and clinical changes of SpO<sub>2</sub> ( $p = 0.8$ ) when comparing the samples from both groups and the surgical procedures performed. The cases in which the values of both analyzed variables were altered, evidencing conditions of tachypnoea or bradypnea and hypoxemia, were isolated cases, not statistically significant.

**Conclusion:** Regardless of the surgical procedures performed, the respiratory pattern remained normal to minimally altered and, in these individuals, there was no direct interference of these surgeries on the respiratory function that caused a significant clinical alteration of respiration.

**Key words:** Surgical Procedures; Respiratory Mechanics; Laparotomy; Cholecystectomy.

## RESUMO:

**Objetivo:** Avaliar e comparar a frequência respiratória e a saturação de oxigênio de pacientes no pós-operatório imediato de laparotomia exploratória e colecistectomia.

**Material e Método:** Trata-se de uma pesquisa transversal, quantitativa, com 63 pacientes atendidos entre novembro de 2014 a abril de 2015. Os dados foram coletados por meio de um questionário estruturado aplicado aos pacientes internados na Clínica Cirúrgica do Hospital Municipal de Imperatriz. Participaram do estudo pacientes de ambos os sexos, com faixa etária entre 18 a 59 anos, no pós-operatório imediato de laparotomia exploratória (Grupo I) e colecistectomia (Grupo II). Do questionário foram extraídos dados relacionados frequência respiratória (FR) e saturação de oxigênio (SapO<sub>2</sub>). Os dados foram analisados estatisticamente empregando-se o programa BioEstat 5.0, bem como teste Shapiro Wilk para normalidade entre variáveis, teste analítico inferencial Mann-Whitney, e teste Spearman para correlação entre variáveis.

**Resultados:** Evidenciou-se que não houve significância estatística quanto a alterações clínicas pertinentes a FR ( $p=0,4$ ) e alterações clínicas da SapO<sub>2</sub> ( $p=0,8$ ) quando comparadas as amostras de ambos os grupos e os procedimentos cirúrgicos realizados. Os casos em que os valores de ambas as variáveis analisadas mostraram-se alterados, evidenciando condições de taquipneia ou bradipneia e hipoxemia foram casos isolados, pouco expressivos estatisticamente.

**Conclusão:** Constatou-se que independentemente dos procedimentos cirúrgicos realizados, o padrão respiratório permaneceu normal a minimamente alterado, não havendo, nesses indivíduos interferência direta dessas cirurgias sobre a função respiratória que provocasse de forma significativa alteração clínica da respiração.

**Palavras-chave:** Procedimentos Cirúrgicos; Mecânica Respiratória; Laparotomia; Colecistectomia.

## RESUMEN:

**Objetivo:** Evaluar y comparar la tasa respiratoria y saturación de oxígeno de los pacientes en el postoperatorio inmediato de la laparotomía exploratoria y la colecistectomía.

**Material y Métodos:** Se trata de un estudio transversal, cuantitativo con 63 pacientes tratados entre noviembre 2014 a abril 2015. Los datos fueron recolectados a través de un cuestionario estructurado aplicado a los pacientes ingresados en la Clínica Quirúrgica del Hospital Municipal Imperatriz. Los participantes del estudio eran pacientes de ambos sexos, con edades comprendidas entre 18-59 años en el postoperatorio inmediato de la laparotomía exploratoria (Grupo I) y colecistectomía (Grupo II). Del cuestionario se extrajeron los datos de tasa por frecuencia respiratoria (FR) y saturación de oxígeno. Los datos fueron analizados estadísticamente empleando el programa BioEstat 5.0 y prueba de Shapiro-Wilk para la normalidad entre variables, análisis de Mann-Whitney inferencial y la prueba de Spearman para la correlación entre las variables.

Se comprobó que no hubo significación estadística en cuanto a los cambios clínicamente relevantes a FR ( $p=0,4$ ) y los cambios clínicos en saturación de oxígeno ( $p=0,8$ ) en comparación con las muestras de ambos grupos y los procedimientos quirúrgicos realizados. Los casos en los que se alteraron los valores de ambas variables analizadas, que muestran las condiciones de taquipnea o hipopnea e hipoxemia fueron casos aislados, poco significativos estadísticamente.

**Conclusión:** Se encontró que, independientemente de los procedimientos quirúrgicos realizados, el patrón de respiración se mantuvo de normal a mínimamente alterado, no habiendo en estos individuos interferencia directa de estas cirugías en la función respiratoria que causase de forma significativa alteración clínica de la respiración.

**Palabras clave:** Procedimientos quirúrgicos; mecánica respiratoria; laparotomía; Colectomía.

## INTRODUCTION

Exploratory laparotomy and cholecystectomy are abdominal surgeries performed above the supraumbilical region that may limit inspiratory capacity, reducing thoracic expansion by 75%, strongly influenced by elevation of the diaphragmatic dome and also by the pain sensation felt at the incision site <sup>(1)</sup>.

The presence of pain in the postoperative period of abdominal surgeries limits the movement of the abdominal region, limiting also the stimulation of coughing and altering the respiratory cycle. In some cases, it may lead to atelectasis, hypoxemia and pneumonia <sup>(2,3)</sup>.

In the first 24 hours that comprise the immediate postoperative period, which is considered a critical phase of the surgical recovery, it is of fundamental importance the monitoring and assistance to the patient through verification of the vital signs until their stabilization, as well as careful evaluation of the functional patterns, mainly respiratory, hemodynamic, thermoregulator, recovery of consciousness and protective reflexes, thus ensuring return to organic homeostasis <sup>(4)</sup>.

The balance of the systems from the 1st postoperative day reflects positively on the other post-surgical recovery days <sup>(4,5)</sup>. In this sense, this study aimed to evaluate and compare the respiratory rate and oxygen saturation of patients in the postoperative period of exploratory laparotomy and cholecystectomy in the first 24 hours after the surgical procedure.

## MATERIAL AND METHODS

The present study is a quantitative and cross-sectional research carried out from November 2014 to April 2015 at the Surgical Clinic of the Municipal Hospital of Imperatriz City, a place aimed at patients who are in the pre and postoperative period.

Patients of both sexes, aged from 18 to 59 years, who were in the immediate postoperative period of high abdominal surgeries of the exploratory laparotomy or cholecystectomy types were included in the study. Patients with pre-existing pneumopathies, patients with a postoperative period of more than 24 hours, patients in clinical situations that were unable to answer to the questionnaire, such as a severe clinical condition, cognitive alteration or mental disorder, were excluded from the study.

All the 63 patients treated during the study period were divided into two groups according to the type of surgical procedure to which they were submitted. Group I (n=41) consisted of patients in the immediate postoperative period of laparotomy and Group II (n=22) consisted of patients in the immediate postoperative period of cholecystectomy.

Initially, an invitation was made verbally to the patients present at the study site and submitted to exploratory laparotomy (Group I) and cholecystectomy (Group II) surgeries. After acceptance, the patients signed a Free and Informed Consent Form

formalizing the participation in the research, as recommended by Resolution 466/2012 of the National Health Council.

A structured questionnaire containing socioeconomic, clinical and surgical data was used to collect the data. Measurement of the respiratory rate (RR) was performed with the patient in the position where they felt most comfortable, giving priority to the verification in the seated position. However, if the patient refused to be in this position, it was performed with the patient in the supine position, and the respiratory incursions per minute (irpm) performed by the patient were counted from the verification of the movement of the thoracic cavity, with eupnea 14 to 20 irpm as parameter<sup>(6,7)</sup>. In order to verify peripheral oxygen saturation (SpO<sub>2</sub>) a More Fitness brand digital oximeter, model MF 417, was placed on the index finger of one of the patients' hands, and values ranging from 95% to 100% were used as normoxemia parameter<sup>(8)</sup>.

The BioEstat 5.0 program was used to analyze the data. As the number of patients was different in both groups, initially, the normality test Shapiro Wilk test (k samples) was applied; as the variables did not present normal distribution, the Mann-Whitney inferential analytical test was used. Subsequently, the correlation between the two variables in the two groups was analyzed using the Spearman test.

This research is part of an umbrella project approved by the Committee of Ethics in Research in Human Beings of the Federal University of Maranhão (CEP-UFMA), with the opinion number 629.315.

## RESULTS

In Group I, the mean age of the patients was 32.2 years, being 29 females and 12 males. In Group II, the mean age was 37.5 years, where 20 were females and 2 were males. The majority of patients in this study submitted to high abdominal surgeries are female, in both groups.

The results obtained from the analyzed clinical variables (RR and SpO<sub>2</sub>) in both groups are shown in tables and figures below. Regardless of the type of surgery that the patients in each group underwent, they did not cause significant respiratory impairment, both clinically and statistically (Table 1).

**Table 1.** Analysis of the respiratory rate and oxygen saturation of patients in the postoperative period of exploratory laparotomy (Group I) and cholecystectomy (Group II).

Variable	Group I					Group II					p
	M	SD	V	P75%	P25%	M	SD	V	P75%	P25%	
RR	21	5.1	1.02	24	18	20.5	3.3	1.01	23	18.2	0.4
SpO <sub>2</sub>	95	3.8	14.9	97	93	94.5	2.5	6.5	97	93	0.8

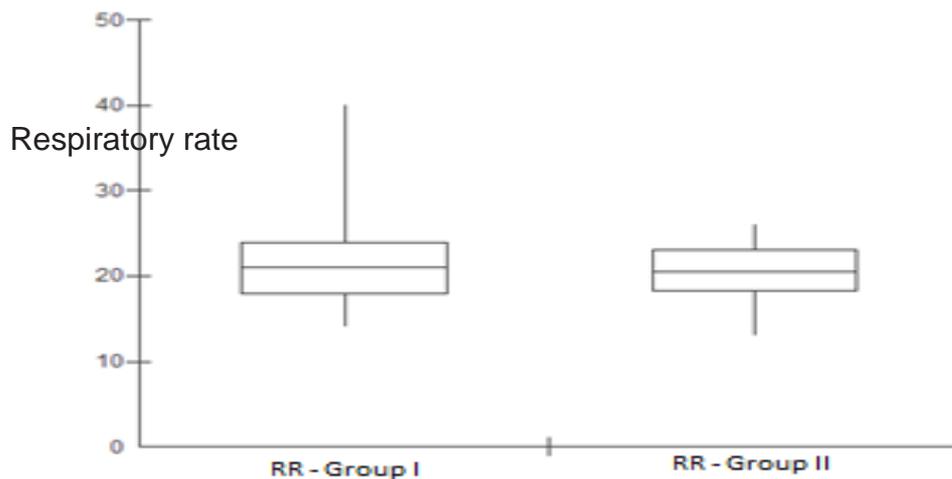
RR: respiratory frequency. SpO<sub>2</sub>: Peripheral oxygen saturation. O<sub>2</sub>: Oxygen. M: Median. SD: Standard deviation. V. P75%: 75<sup>th</sup> percentile, P25%: 25<sup>th</sup> percentile.

Regarding RR, the analysis in 100% of the sample showed a median value of 21 irpm for Group I and of 20.5 irpm for Group II, which was in agreement with the parameters established in the literature. When statistical analysis was applied to these data, p = 0.4 was obtained, showing that there were no statistically significant clinical changes related to this variable in relation to the samples of Group I and Group II (Table 1).

The median of RR in 75% of the sample was higher than that established in the literature, characterizing tachypnea in both Group I (24 irpm) and Group II (23 irpm) (Table 1).

Regarding the minimum and maximum values of RR, Group I had a minimum value of 14 irpm (normal value) and a maximum value of 40 irpm (intense tachypnea); Group II presented a minimum value of 13 irpm (mild bradycardia) and a maximum value of 26 irpm (discrete tachypnea). The Box-Plot graph shows an important difference in the maximum value of both groups, where Group I presented a peak of 40 irpm and presented intense tachypnea, while Group II presented mild tachypnoea (Figure 1).

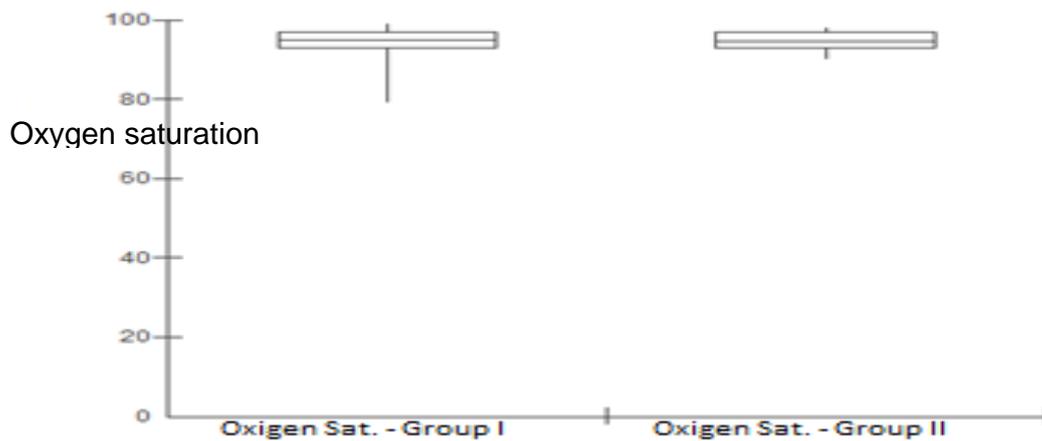
**Figure 1.** Graph showing the minimum value, maximum value and median of respiratory rate.



Regarding SpO<sub>2</sub>, Group I had a median of 95% and Group II had a median of 94.5%, with a value of  $p = 0.8$ . The values found were within normal limits and there was no statistically significant result of clinical change in SpO<sub>2</sub> in both groups. The median values obtained are within that recommended by the literature, and therefore indicate that there was no negative clinical change in this parameter (Table 1).

Regarding the minimum and maximum values of SpO<sub>2</sub>, in Group I, the minimum value found was 79%, characterizing hypoxemia, and the maximum value was 99%, a normoxemic value. In Group II, the minimum value was 90%, a reduced value when compared to the normal standard, but not classified as hypoxemia; and the maximum value found was 98%, a normoxemic value. The most important change occurred in Group I, with a minimum value of SpO<sub>2</sub> with marked hypoxemia. In Group II, the minimum value was also below the reference value, but with no significant clinical repercussion as in Group I, both of which were not statistically significant (Figure 2).

**Figure 2.** Graph showing the minimum value, maximum value, and median of oxygen saturation.



The linear correlation between the RR and the SpO<sub>2</sub> in Group I and Group II it allowed identifying that their values have an inverse proportionality, since as the RR increases evidencing values that characterize tachypnea, the SpO<sub>2</sub>, in turn, decreases evidencing values that characterized hypoxemia. However, this correlation was only statistically significant in Group I patients (p = 0.04) (Table 2).

**Table 2.** Correlation between the respiratory rate and peripheral oxygen saturation of patients in the postoperative period of exploratory laparotomy (Group I) and cholecystectomy (Group II).

Group	RR and SpO <sub>2</sub> r <sub>s</sub> (p)
Group I	-0.3 (0.04)*
Group II	-0.3 (0.1)

r<sub>s</sub>: Spearman's correlation. \* p < 0.05

## DISCUSSION

The analysis in 75% of the sample (Table 1) evidenced alteration in both groups of increased RR, characterizing tachypnea. Increased RR promotes shorter, faster, and shallower respiratory cycles and, according to their intensity, can significantly alter breath quality<sup>(8)</sup>.

Although the RR was altered, the SpO<sub>2</sub> remained with values in agreement with what is recommended in the literature. This may have occurred because the tachypnea present in both groups was mild, and since it was only minimally increased in relation to the physiological value, it did not negatively influence the SpO<sub>2</sub>, because, in this case, despite the respiratory cycle had been slightly faster than normal, it did not happened markedly accelerated and superficially. Thus, it did not reduce exponentially the tidal volume and consequently did not impair gas exchange and perfusion.

Nunes et al<sup>(5)</sup>, when evaluating the complications in the postoperative period of anesthetic recovery, identified an average of 16.2 irpm; after 15 minutes, the mean was 16.4 irpm; after 30 minutes, the average remained, 16.3 irpm; as well as at 45 and

60 minutes, 16.4 irpm and 16.3 irpm, showing a stabilization of the RR in the immediate postoperative period, as evidenced in the present research.

Studies have shown that some level of limitation in pulmonary ventilation is common in laparotomy and cholecystectomy surgeries, considering factors inherent to the surgical procedure, such as pain, diaphragmatic dysfunction, incision extension and proximity to the respiratory system, surgery time and type of anesthesia, which can result in restrictive respiratory disorders<sup>(9,10)</sup>.

However, if it does not occur significantly and the RR remains normal, stable or without significant changes, it means that there was effective control and organic adaptation of the pulmonary ventilation. Associated with these variables, the therapy adopted in the postoperative period, the drug therapy and the general care have shown to be effective in the stability, control and return of homeostasis.

In this regard, postoperative surgical patient therapy for balance of organ systems and prevention of complications mainly consists of pain control by administration of analgesics to promote comfort and less difficulty in breathing, infection prevention with antibiotic prophylaxis, use of aseptic technique in the exchange of dressing and invasive procedures, periodic measurement of vital signs and evaluation of breathing and other systems for early detection of alterations, assessment of hydration conditions and water balance, evaluation of surgical site and drainage devices, bed positioning with high head between 15° to 30°, except when contraindicated, providing comfort and pulmonary expansion, periodical change of position to prevent accumulation of secretions and atelectasis, as well as incentive to deep breathing or teaching and performing of respiratory exercises for alveolar recruitment and improvement in ventilation/perfusion<sup>(4,11)</sup>.

Regarding SpO<sub>2</sub>, the results of medians of Group I and Group II evidenced values in agreement with that set as normal by the literature. RR and SpO<sub>2</sub> present a correlation, in which adequate pulmonary ventilation promotes the supply of alveolar O<sub>2</sub> required for gas exchange and to guarantee satisfactory levels of SpO<sub>2</sub><sup>(8)</sup>.

The more distant the RR is from the eupnea condition, as in isolated cases in which it has been markedly increased and characterizing intense tachypnea, the lower the SpO<sub>2</sub> values, showing hypoxemic values (Table 2). Except for the isolated values of extremes above or below the reference value, in both groups there was a significant normality of these two parameters. In general, RR close to the eupnea condition may have influenced the outcome of normoxemic SpO<sub>2</sub>.

The influence of respiratory rate on blood gases in individuals on the 1st, 2nd and 3rd postoperative days of emergency exploratory laparotomy shows little expressive variations of RR in the first 3 postoperative days with averages that remain above 20 irpm, but do not exceed 30 irpm, being considered mild tachypnea. The partial pressure of carbon dioxide (pCO<sub>2</sub>) changes but it is minimally reduced, and the oxygen partial pressure (pCO<sub>2</sub>) is maintained<sup>(12)</sup>.

It was not the purpose of the study to evaluate the patient on the 1st, 2nd and 3rd days of post-surgical recovery and to measure blood gas levels by arterial blood gas analysis; however, based on the results of the aforementioned study, it is highlighted that the respiratory rate has an influence on the concentration of CO<sub>2</sub> and O<sub>2</sub> in the

blood, and the more it is altered and closer to the physiological value, the lower the changes in the saturation of these gases.

Thus, the findings of this research showed that in the first 24 postoperative hours, the respiratory rate of the individuals of both Group I and Group II occurred a priori without significant impairment, making up a respiratory pattern considered normal to discretely altered. There was a significant normality in the parameters of the analyzed variables in both groups, thus allowing an adequate pulmonary ventilation and gas exchange. And, therefore, the surgical procedures exploratory laparotomy and cholecystectomy did not promote significant functional alteration of the breathing of these individuals.

As a limitation of this study, it was not possible to evaluate all parameters referring to the respiratory pattern due to the lack of spirometry devices that would allow measuring pulmonary capacities and volumes. Also, patients were not monitored throughout the postoperative period, as data collection occurred only in the first 24 hours after surgery; however, the patient may develop respiratory changes during the rest of the recovery days.

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