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Correlation between oxygen therapy and the STOP-BANG score in abdominal surgery under regional anesthesia

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Abstract
Introduction: Oxygen therapy is essential in patients at risk of postoperative desaturation. The STOP-BANG questionnaire identifies respiratory risk factors such as hypoxia. In addition, the type of surgery and anesthesia may influence the need for supplemental oxygen during the postoperative period.
Objective: The aim of this study was to correlate the oxygen therapy dose with the STOP-BANG score in postoperative patients undergoing open cholecystectomy and umbilical plasty under regional anesthesia.
Materials and methods: A descriptive, observational and prospective study was carried out at the Hospital General de Zona No. 20 "La Margarita", in Puebla. We included 201 patients over 18 years of age, to whom we applied the STOP-BANG questionnaire and evaluated the oxygen flow required in the postoperative period.
Results: The results showed significant differences between both groups. Patients with open cholecystectomy had higher STOP-BANG scores and higher oxygen requirement compared to those undergoing umbilical plasty (p=0.000). Chi-square test confirmed this significant association.
Conclusion: There is a correlation between the STOP-BANG score and the need for oxygen therapy, being higher in patients with open cholecystectomy. The use of STOP-BANG could be useful to anticipate postoperative oxygen needs and improve clinical management.

Keywords: Oxygen therapy, cholecystectomy, umbilical plasty, STOP-BANG

Introduction
Oxygen therapy is a fundamental treatment used to increase oxygen concentration in the tissues and organs of patients with oxygen deficiencies. It has been used since 1783, when Dr. Caillens first used it in patients with tuberculosis [1]. Over the years, this intervention has evolved, becoming an essential component in the management of various respiratory and post-surgical conditions. Currently, it is indicated in situations where the partial pressure of oxygen is less than 60 mmHg or when blood hemoglobin saturation is less than 95% [2], conditions that require immediate treatment to avoid severe complications.
Monitoring oxygenation is a key aspect in the use of oxygen therapy. For this purpose, parameters such as respiratory frequency (RF), oxygen saturation (SpO2), partial pressure of oxygen (PaO2), and the PaO2/FiO2 ratio, among others, are used to adjust treatment to the specific needs of each patient [3]. In addition, it is important to consider that prolonged administration of oxygen does not usually generate significant adverse effects, but acute administration can cause respiratory and tissue complications [4]. The devices used for oxygen administration are divided into low-flow devices, such as the nasal cannula and the reservoir mask, and high-flow devices, such as the high-flow nasal catheter and the Venturi mask [5].
The STOP-BANG questionnaire is a widely validated clinical tool for identifying patients at increased risk of respiratory complications prior to surgical procedures. Developed in 2008, this questionnaire allows rapid and accurate identification of risk factors, facilitating preoperative decision making [6, 7]. Its relevance has been confirmed in studies demonstrating its ability to predict events such as oxygen desaturation in patients undergoing surgery. It is

particularly useful in surgical procedures involving general or regional anesthesia, such as cholecystectomy and umbilical hernia repairs [6, 7].

Cholecystectomy, which involves the removal of the gallbladder, is one of the most common surgical procedures. This surgery can be performed open or laparoscopically and is indicated in cases of cholecystitis, symptomatic cholelithiasis, pancreatitis due to stones, among others [8]. Performing this surgery, especially open cholecystectomy, can generate postoperative respiratory alterations due to the type of incision made in the umbilical region, which can limit the patient's ability to breathe deeply and perform actions such as coughing [9, 10]. Furthermore, postoperative pain can restrict abdominal movement, increasing the risk of respiratory complications [11].

The repair of umbilical hernias, which affect between 6% and 14% of abdominal wall hernias [12], also presents postoperative risks, especially respiratory risks. The most common intervention for the resolution of this type of hernia is umbilical plasty, a technique described by Dr. Mayo in 1899 [13, 14, 15]. Postoperative complications, although relatively rare, include respiratory and gastrointestinal disorders and even infections [12, 13, 16]. Patients who are overweight, obese, or those who have experienced changes in intra-abdominal pressure, as in pregnancy, are more prone to develop umbilical hernias [12].

As for anesthesia used in abdominal surgical procedures, regional anesthesia is preferred by many professionals. This type of anesthesia is given directly into the peripheral nerves or central nervous system, blocking pain in the specific region without affecting the patient's airway. Regional anesthesia techniques include neuroaxial block, such as subarachnoid and peridural anesthesia, as well as peripheral nerve blocks [17, 18]. However, regional anesthesia is not without risks, which include duramadre puncture, infections and hemodynamic complications such as altered blood pressure and heart rate [19]. In addition, the use of local anesthetics may increase the risk of respiratory depression, especially when combined with opioids [20].

It is relevant to highlight that, in recent studies, regional anesthesia has been shown to be effective in reducing postoperative pain, although it has also been associated with a higher risk of postoperative pulmonary complications when combined with general anesthesia [21]. Regarding postoperative oxygenation monitoring, several studies have shown the prevalence of hypoxemia in the postoperative period, with factors such as advanced age and the presence of comorbidities as main contributors [22, 23]. In this context, the administration of supplemental oxygen and the use of devices such as CPAP have been shown to be effective in reducing respiratory complications in patients with transoperative hypoxemia [24].

Proper management of oxygen therapy, the identification of respiratory risks by means of tools such as STOP-BANG and the selection of appropriate anaesthesia are essential to improve postoperative results, especially in patients undergoing abdominal surgery. Advances in research and knowledge of techniques and devices used for oxygen delivery and anaesthesia remain essential to the continuous improvement of medical care in these patients [1-21].

Materials and Methods

- Based for the general objective: Descriptive.
- Based on the researcher's intervention: Observational.
- Based on the temporality: Transversal
- Based for the collection of data: Prospective.
- Based on the number of participating centers: Single-center.

The research was carried out in the department of Anesthesiology in the operating room area of the General Hospital of zone 20, Puebla.

Selection Criteria

a) Inclusion Criteria

- Both genders.
- Age over 18 years old up to 70 years old.
- Postoperative patients of elective open cholecystectomy or emergency cholecystectomy.
- Postoperative patients of elective or emergency umbilical plasty.
- Patients under regional anesthesia.
- Patients who agreed to participate in the study and signed informed consent letter.
- Patients with ASA I and II

b) Exclusion Criteria

- Pregnant patients
- ASA III, IV, V, VI
- Patients with use of domiciliary oxygen
- Previously pneumopathic patients

c) Elimination criteria

- Patients who requested voluntary discharge from the service.
- Incomplete data on the data collection sheet.
- Patients who presented complications and needed to be admitted to intensive care.
- Patients who refused to continue participating in the study.

Patients who met the selection criteria were included, to whom the study protocol was explained and, after signing the informed consent form together with their companion, relevant clinical data were collected.

The data collection process was completed at the time of recruiting patients who underwent the STOP- BANG questionnaire with verification of the dose of oxygen therapy used based on the score obtained in the questionnaire in postoperative cholecystectomy patients and in postoperative umbilical plasty patients under neuroaxial blockade. Data were captured in Excel and analyzed with SPSS v25.0. The results of the study were presented using descriptive and inferential statistics. Descriptive statistics were reported for qualitative variables by frequencies and percentage; quantitative variables were reported by mean and standard deviation for those with normal or Gaussian distribution; for non-normal or non-Gaussian distribution by median and interquartile range. For the correlation of our two groups (cholecystectomy and umbilical plasty), the X^2 test was used.

Results

Once the data collection strategy was carried out, the selection criteria were assessed and 201 patients (n=201) were found to be included in the study.

Table 1: Clinical characteristics of the study population.

		N (%)
Total patients		201
Postoperative open cholecystectomy patients		
Number of postoperative cholecystectomy patients		81
Age		
	18-30	8 (89.9)
	31-60	48 (59.3)
	61-90	25 (30.9)
Gender		
	Male	29 (35.8)
	Female	52 (64.2)
Postoperative patients of umbilical plasty		
Number of patients postoperatively from umbilical plasty		120
Age		
	18-30	23 (19.2)
	31-60	64 (53.3)
	61-90	33 (27.5)
Gender		
	Male	42 (35)
	Female	78 (65)

Table 1 describes 201 operated patients, of which 81 were open cholecystectomy and 120 umbilical plasty. In both cases, the majority were women (64.2% and 65% respectively) and persons between 31 and 60 years of age (59.3% and 53.3% respectively).

Table 2: Type of regional anesthesia in the study population

Open cholecystectomy	N (%)
Subarachnoid block	3 (3.7)
Epidural block	0
Mixed blocking	78 (96.3)
Umbilical plasty	
Subarachnoid block	13 (10.8)
Epidural block	3 (2.5)
Mixed blocking	104 (86.7)

Table 2 shows the type of regional anesthesia used in the study patients. In both surgical groups (open cholecystectomy and umbilical plasty), mixed block was the most used, with 96.3% and 86.7%, respectively. Subarachnoid block was used less frequently, and epidural block was uncommon, especially in cholecystectomy, where it was not used.

Table 3: STOP-BANG questionnaire score in two types of surgical procedures.

Open cholecystectomy	N (%)
Low	27 (33.3)
Medium	53 (65.4)
High	1 (1.2)
Umbilical plasty	
Low	107 (89.2)
Medium	13 (10.8)
High	0

Table 3 shows the risk levels of sleep apnea according to the STOP-BANG questionnaire score in patients undergoing two types of surgery. In open cholecystectomy, the majority had medium risk (65.4%) and a small percentage had high risk (1.2%). In contrast, low risk predominated in umbilical plasty (89.2%), with no cases of high risk.

Table 4: Oxygen flows based on the STOP-BANG score in two types of surgical procedures.

Open cholecystectomy	L/min	N (%)
Low		
	<2	24 (88.9)
	>3	3 (11.1)
Medium		
	2.1-3	46 (86.8)
	>3	7 (13.2)
High		
	<2	
	2.1-3	
	>3	
Umbilical plasty		
Low		
	<2	107 (100)
Medium		
	2.1-3	12 (92.3)
	>3	1 (7.7)
High		
	<2	1 (100)

In Table 4, administered oxygen flows were evaluated according to the STOP-BANG questionnaire score in patients undergoing open cholecystectomy and umbilical plasty. In open cholecystectomy, low-risk patients received flows lower than 2 L/min (88.9%), while at medium risk, flows between 2.1-3 L/min were used in 86.8% of the cases. In umbilical plasty, 100% of patients with low risk received less than 2 L/min. At the average risk, most (92.3%) received between 2.1-3 L/min.

Table 5: Chi-square tests both surgical procedures

STOP BANG score and oxygen flows used in open cholecystectomy	
Pearson's chi-square	P value
71.851a	.000
STOP BANG score and oxygen flows used in umbilical plasty	
120.000a	.000

In Table 5, the chi-square test was performed to analyze the association between the STOP-BANG questionnaire score and the oxygen flows used in two surgical procedures. In open cholecystectomy a chi-square value of 71,851

(p=0.000) was obtained, while in umbilical plasty it was 120,000 (p=0.000), demonstrating in both cases a statistically significant association between risk of sleep apnea and intraoperative oxygen requirements.

Discussion

This study applied to 201 patients allowed the analysis of several key factors that influence the need for oxygen therapy and its correlation with the STOP-BANG score. Patients with open cholecystectomy had a higher score on the STOP-BANG questionnaire. This finding is consistent with the fact that these patients may experience greater comorbidities and respiratory risks in the postoperative period, which agrees with Fernández and collaborators in their observational study, retrospective carried out in Mexico at the Naval Medical Center, published in 2020 where the high STOP-BANG, was associated with oxygen desaturation and cardiovascular risk factors. The Mann-Whitney test was used to support the hypothesis that the type of surgery significantly influences the risk score evaluated by the STOP-BANG questionnaire.

The mixed block was the most common in both types of surgery, considering that, according to the prospective observational study conducted in Chile from 2005 to 2007 by Viscido G and collaborators, regional anesthesia is common in patients treated for umbilical plasty, which is consistent with this result. However, a retrospective study conducted by Salamanca N. in Colombia from 2002 to 2004, where he applied regional anesthesia in open cholecystectomy, patients remained hemodynamically stable, with minimal postoperative alterations and adequate pain management, so it may be related to the frequent use of this type of anesthesia in these patients.

Comparison of oxygen therapy flows between these two procedures shows that open cholecystectomy patients required higher oxygen flows, which is highly significant. This supports the hypothesis that the type of surgical procedure significantly affects the need for postoperative oxygen therapy. This is similar to a 2008 meta-analysis by Ferreyra *et al*. of patients undergoing abdominal surgery who developed hypoxemia during the postoperative period, and therefore the use of CPAP and supplemental oxygen decreased the incidence of pulmonary complications.

The oxygen flows used vary significantly according to the different questionnaire scores in both procedures, in contrast to the aforementioned study by Fernández *et al*., where high STOP-BANG was associated with oxygen desaturation and the presence of cardiovascular alterations.

Finally, the rate of oxygen saturation with inspired oxygen fraction was mild so that most patients achieved adequate oxygen saturation during the postoperative period, which may be associated with the type of anesthesia, as indicated by Bartels and collaborators in their prospective multicenter study published in 2022 in the US. US, where combined regional anesthesia had lower demand of oxygen therapy in the postoperative period.

Conclusion

In this study, it was verified that there is a significant association between the oxygen therapy dose and the STOP-BANG score in postoperative patients of open cholecystectomy compared to umbilical plasty under regional anesthesia. According to the study evidence, patients with open cholecystectomy required higher oxygen flows, presenting high STOP-BANG scores.

These results show the importance of correlating the STOP-BANG score with the oxygen therapy needs in the postoperative period. Patients undergoing open cholecystectomy tend to have risk factors represented in the STOP-BANG questionnaire that may require higher oxygen flows compared with patients undergoing umbilical plasty, combined with the manipulation and surgical time in an open cholecystectomy is greater than an umbilical plasty.

Although the results suggest that umbilical plasty is more common than open cholecystectomy in this study group, the need for close monitoring in patients with moderate or high STOP-BANG scores is of utmost importance.

Despite the increased need for oxygen therapy in cholecystectomy patients, the rate of oxygen saturation was maintained at an adequate level in both groups. This suggests that although the need for supplemental oxygen varies, most patients manage to maintain adequate oxygenation during the postoperative period.

This study has shown the influence of surgical procedures on the need for postoperative oxygen therapy, highlighting the importance of considering risk factors as well as the type of intervention and demographic characteristics of patients. It is essential to recognize that this research has limitations, including the lack of long-term follow-up and the need to consider additional factors such as co-morbidities. Future research could extend these findings through multicenter studies and analysis to a larger population.

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