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Ramos Díaz Sayra Lizett
Universidad Popular Autónoma de Puebla, Puebla, México

Alcázar Ramiro Guadalupe
Hospital General de Zona No 20, Puebla, México

Díaz Merino Gerardo
UMAA San Alejandro, Puebla, México

Ortega Aguirre Melissa
Hospital General de Zona No 20, Puebla, México

Corresponding Author:
Ramos Díaz Sayra Lizett
Universidad Popular Autónoma de Puebla, Puebla, México

Determination of postoperative complications in ASA II patients undergoing elective cholecystectomy, with fasting greater than 8 hours

Ramos Díaz Sayra Lizett, Alcázar Ramiro Guadalupe, Díaz Merino Gerardo and Ortega Aguirre Melissa

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Abstract
Preoperative fasting is an important part of preparing patients for elective surgery. Its importance lies in preventing risks and complications such as Broncho aspiration and avoiding metabolic imbalances. Most patients are not 100% healthy; they have some type of comorbidity, the majority being diabetes and hypertension, which, when controlled, classifies them as ASA II. Prolonged fasting can be harmful to patients by creating metabolic imbalances. Currently, there are guidelines and protocols, such as the Enhance Recovery After Surgery (ERAS) protocol, which governs the guidelines to follow regarding fasting and is beneficial for both the patient and the medical staff, by improving the pre-, trans-, and postoperative conditions of patients.

Keywords: Glucose, blood pressure, fasting, patients, elective surgery

Introduction
The American Society of Anesthesiologists (ASA) physical status is a classification system adopted by all anesthesiologists and used to classify the general health status of patients [1].
In 1961, Dripps proposed an initial scale to classify patients. However, it wasn't until 1963 that the American Society of Anesthesiologists (ASA) described the scale, classifying it into five categories. In recent years, an additional group for organ donors has been added. This scale aims to stratify patients' health status and also helps determine anesthetic or surgical risk. This classification depends on each anesthesiologist [2].

This system divides patients into 6 different states:

- **ASA I:** Healthy patient (associated with a 0.3% mortality rate).
- **ASA II:** A patient with mild to moderate (controlled) systemic disease. Examples: controlled hypertension or diabetes mellitus, grade I and II obesity, social drinker, smoker (associated with a 0.3-1.4% mortality rate).
- **ASA III:** A patient with severe (uncontrolled) systemic disease. Examples: uncontrolled hypertension or diabetes mellitus, morbid obesity (associated with a 8-5.4% mortality rate).
- **ASA IV:** A patient with severe, life-threatening systemic disease. Examples: Unstable angina, symptomatic heart failure (associated with a 7.8-25.9% mortality rate).
- **ASA V:** A moribund patient who is not expected to survive without surgery. Examples: ruptured aortic aneurysm, massive trauma, and extensive intracranial hemorrhage with mass effect (Associated mortality 9.4-57.8%).
- **ASA VI:** Brain-dead patient who is a potential organ donor [3].

A correct ASA classification will allow us to truthfully communicate the potential risks of the procedures the patient will undergo and, at the same time, take the necessary precautions for anesthesia.
Another important aspect of assessing and preparing our patients for surgery is preoperative fasting. Its implementation has been done to avoid the most common and feared complication in the operating room: Pulmonary aspiration of gastric contents.

This is a rare situation, but if it occurs, it can be fatal for the patient. Therefore, different preoperative techniques have been developed to help prevent this, such as preoperative fasting, rapid sequence induction, and the application of cricoid force to prevent this occurrence [4]. The objective of fasting a patient is to reduce gastric contents and thus avoid a potentially fatal complication [5].

The importance of preoperative fasting dates back to the 1990s, since during those years, the rule was "nothing by mouth after midnight". Over time, different practices and scientific evidence no longer supported this view. It was shown that, contrary to what was believed, prolonged fasting caused increased gastric contents, which was related to lower pH (acidity), and could also lead to hypoglycemia, dehydration, and general malaise associated with hunger, thirst, and anxiety [6].

During the fasting phase, what is known as the migratory motor complex appears. This consists of waves of electrical activity that appear in regular cycles and are produced by vagal stimulation. These waves appear every 45-180 minutes and are composed of 4 phases:

- **Phase I:** Resting period.
- **Phase II:** Increased action potentials and low-amplitude smooth muscle contractility.
- **Phase III:** Bursts of regular, high-amplitude contractions occur.
- **Phase IV:** Decreased activity that merges with Phase I.

This type of contractions causes undigested food waste to spread through the digestive tract and, in turn, displaces bacteria from the small intestine to the large intestine [7]. During periods of hunger, these waves appear with low pressure and occur at a rate of 3 per minute (tone rhythm). After a certain period of time, these waves manifest with higher pressures that can last up to 30 seconds and appear in short periods (type I contractions), when the activity of the empty stomach increases. These contractile waves overlap each other (type II contractions). During periods of prolonged fasting, gastric motility increases, generating type III contractions, also known as gastric tetany. These are rapid peristaltic waves along the stomach, which is in a state of sustained tone. These "hunger" contractions end when food is ingested [8].

Gastric emptying time is different for liquids, solids, and semi-solids. For solids, it depends on the cooking method, particle size, and the amount of food consumed. Calorie and composition. Low-calorie clear liquids take approximately 2 hours to empty, unlike high-calorie, non-clear liquids, which can take more than 2 hours to empty. Solid-liquid combinations take between 4 and 7 hours, and fried foods of similar composition take even longer.

It is recommended that healthy adults drink clear liquids containing carbohydrates up to 2 hours before elective procedures requiring general or regional anesthesia or sedation. The recommended volume is 400 ml. They may contain simple or complex carbohydrates. According to studies, patients who consume clear liquids with carbohydrates experience less hunger and thirst compared to fasting patients and less hunger compared to calorie-free clear liquids. Regarding patients who chew gum, studies show a minimally increased residual gastric volume at anesthesia induction compared to fasting patients, so discontinuing surgery is not recommended due to this [9].

The stomach always has a basal volume due to continuous gastric secretion; fasting is considered acceptable if gastric volume returns to its basal levels [10].

Enhanced recovery after surgery (ERAS) is a protocol used to improve outcomes and enhance the recovery phase after surgery.

Normal metabolism is in constant interaction with catabolic and anabolic hormones. Any significant injury can produce insulin resistance. This is defined as a condition in which a normal insulin concentration produces a subnormal biological response. In a multifactorial study, the degree of insulin resistance, the extent of surgery, and blood loss were the three factors that explained more than 70% of the variation in hospital stay. Prolonged preoperative fasting increases metabolic stress, hyperglycemia, and insulin resistance; Methods that can help reduce this insulin resistance include adequate pain relief, early postoperative nutrition, and carbohydrate loading [11].

Nightly intravenous glucose therapy, rather than an overnight fast, attenuates the decrease in muscle insulin sensitivity. Preoperative oral carbohydrate administration increases insulin sensitivity, extending into the postoperative period, thereby reducing insulin resistance by up to 50%. This administration shifts cellular metabolism to a more anabolic state, resulting in a lower risk of hyperglycemia, improved protein retention, and consequent preservation of lean mass. Studies conducted in relatively small patient populations suggested improved outcomes with preoperative complex carbohydrates administered orally up to 2 hours before anesthesia and surgery, leading many national and international anesthesia societies to recommend a 6-hour preoperative fast for solids and a 2-hour fast for clear liquids, including carbohydrate beverages [12].

Cholecystitis is one of the leading causes of abdominal emergencies and, if untreated, can lead to gallbladder perforation, sepsis, and death. Risk factors associated with this condition include obesity, diabetes mellitus, estrogens, pregnancy, hemolytic, liver, and metabolic diseases, and cirrhosis [13].

Cholecystectomy is a surgical procedure in which the gallbladder is removed. It is considered one of the most performed surgical procedures worldwide. Laparoscopy is currently the gold standard for surgical treatment due to its rapid recovery and minimal surgical trauma. Among the main complications derived from this procedure are infections, hemorrhages, intestinal injuries, fistulas, and biliary injuries, the latter being the most frequent surgical complication, reaching an incidence of 0.2-0.4% and a mortality rate of 13%. Another complication associated with the procedure is the presence of chronic postoperative pain in up to 23% of patients [13, 14].

Now, taking into account that patients with ASA II have some type of comorbidity, various studies report that 55% of diabetic patients undergoing surgery have had some type of postoperative complication, the most common being wall infection, followed by wall dehiscence and seromas. Diabetes mellitus is a metabolic disease characterized by periods of chronic hyperglycemia. It is considered the disease with the highest morbidity, and surgical risk correlates with the complications that exist.

Materials and Methods

Research Type and Design

- **General objective:** Descriptive.
- **Researcher's approach:** Analytical
- **Timeframe:** Longitudinal.
- **Structure:** Single-center.
- **Data collection:** Prospective.
- **Study Population:** Beneficiaries of the Mexican social security institute scheduled for elective cholecystectomy at general Hospital Zone Number 20 "La Margarita".

Inclusion Criteria

- Beneficiaries over 18 years of age.
- Both male and female.
- Scheduled for elective cholecystectomy.
- Fasting for at least 8 hours or more
- Those with ASA II surgical risk
- Those who agree to participate in the study and sign an Informed Consent Letter

Exclusion criteria

Emergency cholecystectomy

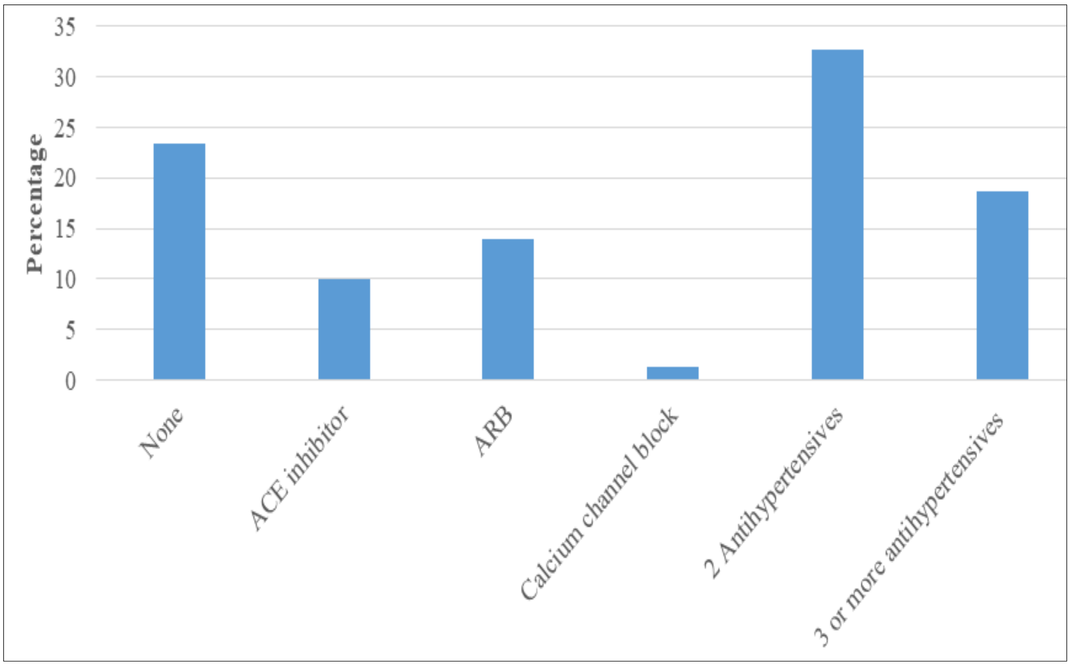
Elimination criteria

- Patients who requested to be withdrawn from the study
- Incomplete data on the data collection form
- Patients with any type of physical or mental condition that prevented them from following medical instructions and who did not have a responsible person or guardian.

The study protocol was explained to the patients, and after they signed the informed consent form along with a companion, relevant clinical data were collected. Pre-anesthetic, trans-anesthetic, and post-anesthetic capillary glucose levels, as well as blood pressure, were measured at the same time points. Mean arterial pressure was subsequently obtained. Patients were questioned about their fasting duration at the time of the pre-anesthetic glucose measurement. All collected information was saved in Excel, and data analysis was performed using SPSS v. 25. After univariate analysis, an inferential analysis was performed in two stages: first using bivariate analysis based on mean differences and then using Spearman's test to correlate fasting duration with changes in blood glucose and mean arterial pressure.

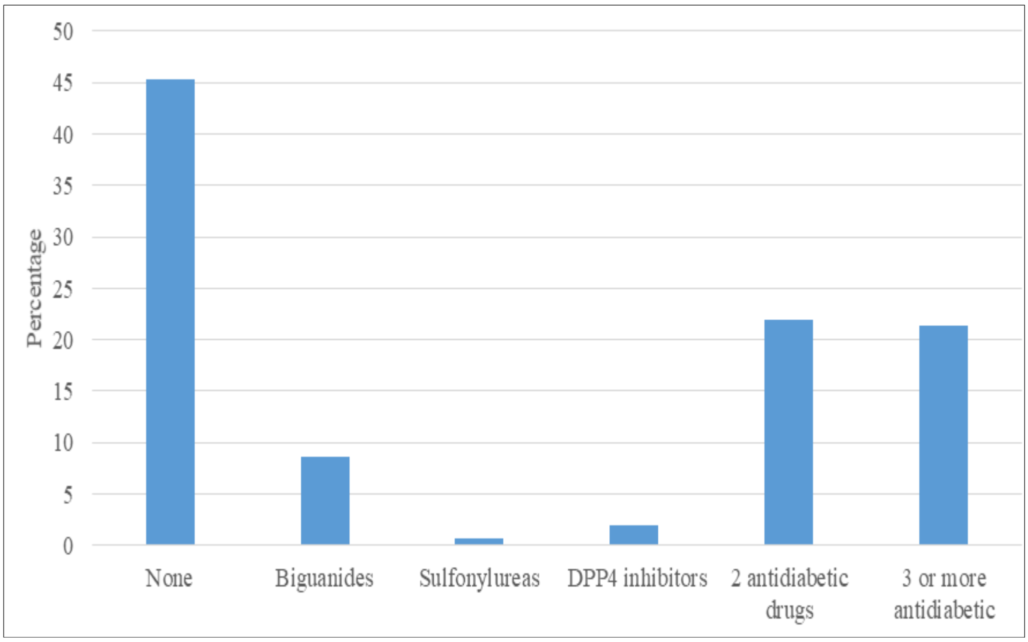
Results

A total of 150 patients were analyzed, of whom 40.7% (N=61) were women and 59.3% (N=89) were men. The median age was 51 years (RI=8) of the total population, 54.7% (N=82) were diabetic, and 76.7% (N=115) had hypertension of the total hypertensive patients, 70.7% (N=106) reported taking their medication prior to surgery. In the case of diabetic patients, 100% did not take their primary medication prior to surgery (See Figure 1 and 2).



Abbreviations: ARB: Angiotensin II Receptor Blockers, ACE inhibitor: angiotensin-converting enzyme inhibitors

Chart 1: Type of antihypertensive



Abbreviations: DPP4: dipeptidyl peptidase 4

Fig 2: Type of antidiabetic

Regarding glucose values prior to the procedure, the following were obtained:

Table 1: Capillary glucose

	Preanesthetic glucose	Transanesthetic glucose	Postanesthetic glucose
Median	105.00	109.00	111.00
Interquartile range	38	38	39

Regarding mean arterial pressure we find the following:

Table 2: Mean arterial pressure

	Preanesthetic	Transanesthetic	Postanesthetic
Median	94.6667	93.5000	96.3333
Interquartile range	7.83	8	7.33

Considering the patients' fasting hours, none of our patients complied with 8 hours or less of fasting, 76.7% (N=115) of the patients had between 9-12 hours of fasting and 23.3% (N=35) more than 12 hours (Figure 3).

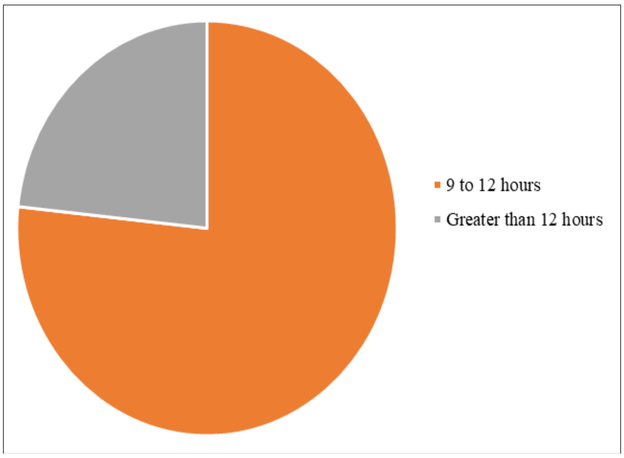


Fig 3: Fasting hours

When analyzing the data, we observed that the median pre-, trans-, and post-glucose levels were above 100 mg/dL, indicating that the patients were experiencing hyperglycemia. This is expected given the diabetic patients. However, the median in our sample was below 150 mg/ml, indicating that the midpoint was under control.

The most common complication was hyperglycemia, distributed as follows:

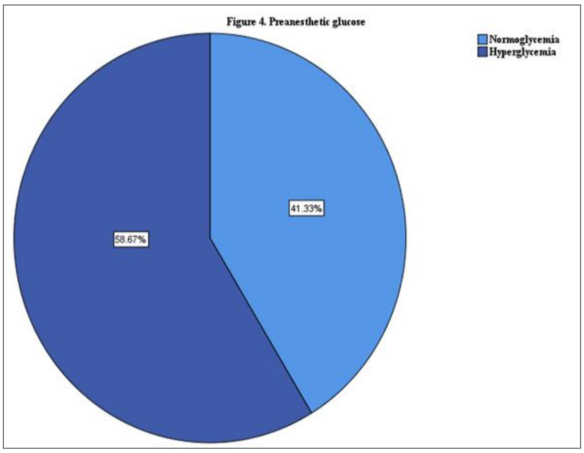


Fig 4: Distribution of postoperative complications observed in ASA II patients undergoing elective cholecystectomy after prolonged fasting.

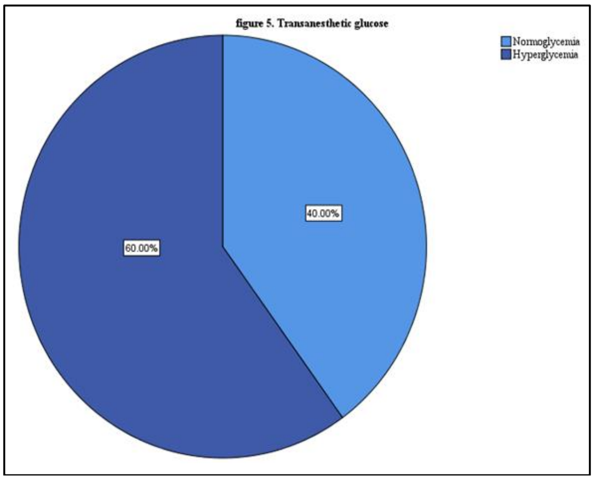


Fig 5: Trends in capillary glucose values (pre-anesthetic, trans-anesthetic, and post-anesthetic) showing the impact of fasting duration

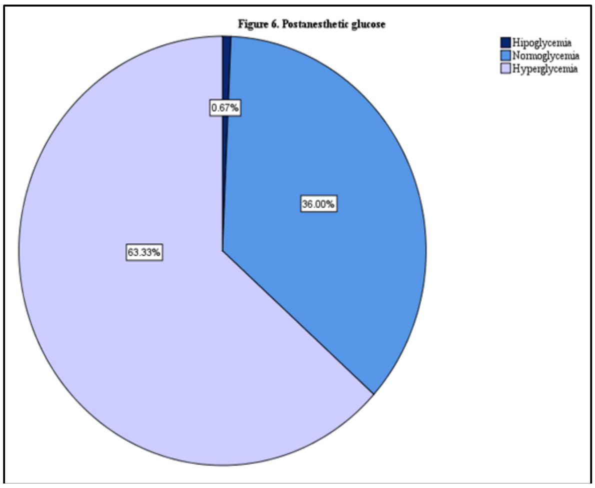


Fig 6: Correlation between fasting hours and postoperative glucose levels, indicating the relationship between prolonged fasting and hyperglycemia.

In the case of mean arterial pressure, the results behaved as follows:

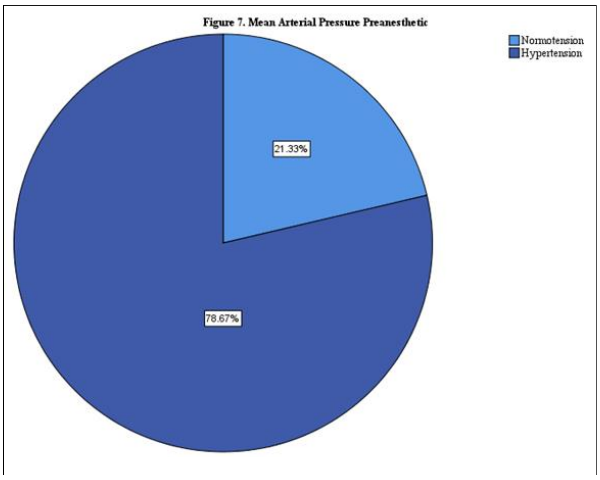


Fig 7: Correlation between fasting hours and postoperative mean arterial pressure (MAP), demonstrating the absence of significant association.

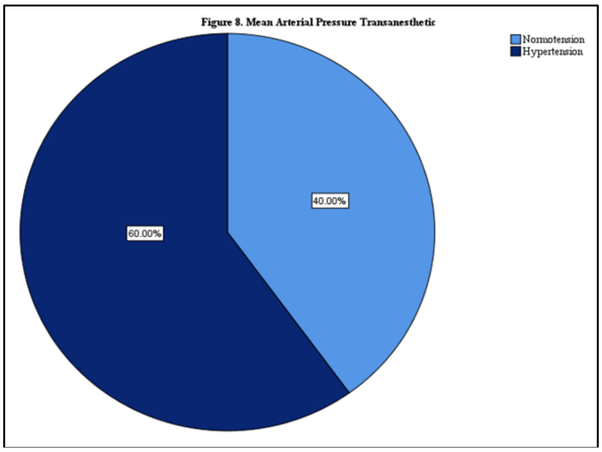


Fig 8: Comparison of perioperative hemodynamic stability (heart rate and MAP) between patients with standard versus prolonged fasting durations

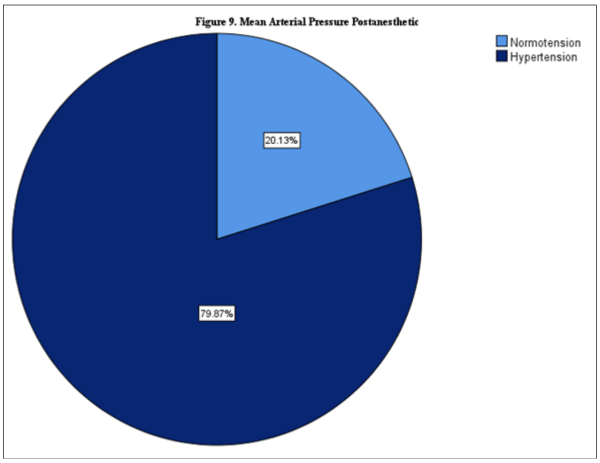


Fig 9: Overall incidence of adverse events stratified by fasting duration, highlighting the clinical impact of prolonged fasting on ASA II patients.

When correlating the samples with Spearman's Rho of post-anesthetic glucose with fasting, we obtained a statistically significant moderate correlation.

Table 3: Glucose correlations

			Postanesthetic glucose	Fasting hours
Spearman's Rho	Postanesthetic glucose	Correlation coefficient	1.000	.368**
		Sig. (bilateral)	.	.000
		N	150	150
	Fasting hours	Sig. (bilateral)	.368**	1.000
		Sig. (bilateral)	.000	.
		N	150	150

**. The correlation is significant at the 0.01 level (two-tailed).

When correlating post-anesthetic mean arterial pressure (MAP) values with fasting hours using Spearman's Rho, there was no statistically significant difference between them, so the longer the fasting time, the less changes in MAP.

Therefore, the complication that arose with respect to the hours of fasting was hyperglycemia

Table 4: Blood pressure correlations

			Fasting hours	Post-anesthetic MAP
Spearman's Rho	Fasting hours	Correlation coefficient	1.000	.126
		Sig. (bilateral)	.	.125
		N	150	150
	Post-anesthetic MAP	Correlation coefficient	.126	1.000
		Sig. (bilateral)	.125	.
		N	150	150

Therefore, the complication that arose with respect to the hours of fasting was hyperglycemia.

Discussion

The research carried out aimed to evaluate how both MAP and glucose behaved in ASA II patients who underwent elective cholecystectomy, based on the study of demographic variables we found that the majority of patients were men; Contrary to what different bibliographies mention, that it is a predominant pathology in women, this could have been due to the sample collection.

Noba and Wakefield in London, 2019 [25] conducted a review of randomized controlled trials finding a sample of 2065 patients where preoperative carbohydrate drinks reduced insulin resistance and improved postoperative discomfort of patients, especially in those who underwent laparoscopic cholecystectomy. No impact of these drinks on gastric volume and pH was found, and events such as bronchoaspiration were not reported either. Therefore, the use of these drinks 2 hours prior to surgery is considered safe. Compared to our study, there was no use of these types of beverages, much less a minimum fast of 2 hours; 76.67% of our patients fasted for more than 12 hours, and 0% fasted for less than 8 hours. Sosa, *et al.* in Mexico, 2021 [17] carried out a bibliographic review and conducted a descriptive study finding that patients with diabetes are more likely to require surgery and that 40% of them are complicated by hyperglycemia and of this percentage, 25% reach glucose levels greater than 180 mg/dL, comparing what was found by Sosa with our study, we observed that the median pre, trans and post glucose levels were between 92-95 mmHg, however, when correlating the hours of fasting with post-surgical glucose, we realized that these figures went hand in hand as time passed, this could have been due to the fasting time, the omission of taking antidiabetic medications and surgical trauma. Palermo and Garg in Boston, 2019 [15] conducted a review of observational studies finding that the presence of diabetes is linked to poor clinical outcomes since they found that the higher the postoperative glucose levels, the greater the risk of complications, they also found that the use of insulin infusion after 72 hours after the intervention the incidence of surgical site infection decreased to levels similar to those in healthy patients, in the case of our study, these patients were not followed up long-term to observe the evolution, and although the average glucose was less than 140 mg/dL, it is a controlled environment, where patients are monitored, it would be worth conducting a new study to assess long-term complications. The same authors created a clinical program aimed at improving glucose levels in diabetic patients, requesting glycosylated hemoglobin to rectify glucose level control and, based on this program, implementing actions to improve the pre-, trans-, and postoperative periods, thus improving patients' surgical outcomes. It would be worthwhile to introduce this measurement in scheduled patients and not just rely on fasting glucose to assess glycemic control.

In a series of case studies conducted by Matoses *et al*. in Spain in 2019 [23], they mention that no high-quality randomized controlled studies have been conducted or found related to the treatment of hypertension in major surgery patients, and that uncontrolled hypertension has been linked to an increase in peri- and postoperative complications. We recommend that patients with BP less than 130/80 mmHg (Equivalent to a MAP < 96 mmHg) not discontinue beta-blocker medications and analyzing cohort studies found that patients who discontinued ACEI and ARB were less prone to hypotension situations in the operating room, in our sample the median was 92-95 mmHg with a mode of 94 mmHg, within normal parameters, 100% of patients took their medication on the day of surgery, however other factors that may influence blood pressure figures such as the use of amines, pneumoperitoneum pressure, or the type of anesthesia were not taken into account. Ripollés *et al.* in Spain, 2020 [22] conducted a bibliographic review where they found that hypertensive patients have a lower threshold of tolerance to hypotension, making them more susceptible to cerebral hypoperfusion with the consequent delirium or other cardiovascular complications, so the higher the BP value, the higher the incidence of complications. In our sample, no complications were found in hypertensive patients, so there were no immediate delirium events.

The same researchers found that several factors can influence blood pressure loss in the operating room, such as anesthesia induction, inadequate analgesia, and even poor ventilator coupling and management. These factors were not taken into account in our study. At the same time, factors that could have influenced blood pressure measurement in our study included the type of anesthesia (general or neuraxial) and the type of surgery used (open or laparoscopic). As the researcher mentioned, pain control, the effects of pneumoperitoneum, or, alternatively, surgical exposure, can modify blood pressure levels; therefore, our results were biased. You live in Spain, 2020 [24] in his case analysis finds that a 30% decrease in patients' basal blood pressure is associated with greater myocardial damage and in the case of hypertension it can lead patients to the presence of bleeding, with respect to fasting time, when there is a decrease in blood volume due to lack of fluid intake, patients present with hypotension, they found that this is added to the effect of the various anesthetic agents used to perform the surgical event, in our research the median blood pressure was 94-96 mmHg, keeping the blood pressure figures under control despite the prolonged fasting time, so our findings differ from those reported in the literature by not reporting periods of hypotension, however, again emphasis is placed on the omission of the measurement of other factors that could influence the results

Conclusion

The most common postoperative complication in patients undergoing elective cholecystectomy with a preoperative ASA II score and fasting for more than 8 hours was hyperglycemia (63.33%) and hypertension (79.87%).

We can conclude that while fasting time did not have an effect on the vascular level, it did have an effect on the metabolic level, with the presence of hyperglycemia peaks. Therefore, special attention must be paid to the preoperative instructions given to patients, in order to ensure the most effective recovery possible and shorten the hospital stay.

Although we did not obtain significant changes in blood pressure, it would be worthwhile to conduct a new study in the future that encompasses or takes into account factors that could modify this response to obtain a more reliable result.

We should try to implement ERAS guidelines to protocolize fasting and thus reduce insulin resistance caused by both surgical stress and metabolic stress itself, while also optimizing medication administration, indicating when to properly discontinue medications and when to appropriately reduce doses, in the case of insulin. Likewise, intraoperative monitoring of both blood pressure and glucose levels should be performed to treat, when necessary, and prevent both cardiovascular and metabolic complications.

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Conflict of Interest

Not available

Financial Support

Not available

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