



# Profile of Laparoscopic Appendectomy Complications in a Private Hospital in the Northern Region of Brazil, Eastern Amazon

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

## **Article Information**

DOI: 10.9734/JAMMR/2024/v36i15350

## **Open Peer Review History:**

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/112266>

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## ABSTRACT

Acute appendicitis (AA) is caused by inflammation of the vermiform appendix, with many hypotheses justifying the aetiology of this disease. One of the main aetiologies is obstruction of the appendicular lumen, either by faeces, vegetable seeds, a foreign body or a neoplasm, which increases the luminal pressure of the appendix, with consequent impairment of the vascular supply to the appendicular wall and, therefore, inflammation, necrosis and perforation. Laparoscopic appendectomy is the gold standard surgical procedure currently used for acute appendicitis. It is minimally invasive and has many advantages. Laparoscopic appendectomy has shown a significant advantage over open surgery, as it has the benefit of shorter hospitalisation times, less post-operative pain, a lower rate of complications after surgery and mortality, and lower costs. For this reason, this study aimed to analyse the data obtained on complications associated with laparoscopic appendectomies performed on patients at a private hospital in the northern region between 2020 and 2022. This is an observational, retrospective and descriptive study analysing medical records with a cross-sectional quantitative analysis of the complications of laparoscopic appendectomy. The aim was to describe the main complications in patients undergoing laparoscopic appendectomy and contribute to the scientific framework on the subject.

**Keywords:** Appendectomy; videolaparoscopy; general surgery; complications.

## 1. INTRODUCTION

Acute appendicitis (AA) is caused by inflammation of the vermiform appendix, with many hypotheses justifying the aetiology of this disease. One of the main aetiologies is obstruction of the appendicular lumen, whether by faeces, vegetable seeds, foreign bodies or neoplasms, which increases the luminal pressure of the appendix, with consequent impairment of the vascular supply to the appendicular wall and, therefore, inflammation and perforation [1].

Its clinical picture ranges from simple, self-limiting and benign diagnoses to life-threatening ones that require early surgical intervention [2]. In order to establish the diagnosis of appendicitis in the current study, the clinical history and physical examination were relevant, using three main variables: the presence of pain, peritoneal irritation and the presence of a mass or plastron indicating blockage by intestinal loops or omentum in the inflamed appendix [3].

The stage of presentation of AA, the time from complaint to seeking care and advanced age are considered prognostic factors for appendectomy, as they are correlated with a worse prognosis during hospitalisation, increasing the length of hospital stay and the presence of postoperative

complications LAMM *et al.*, [18] GUTIERREZ *et al.*, [4]

There has been a growing increase in the incidence of acute appendicitis in newly industrialised countries, such as Brazil. Although it is a condition that can affect all age groups, AA has a higher incidence among young adults [5].

Acute appendicitis is the most common cause of surgical acute abdomen, and post-operative complications in the emergency room are a reflection of the surgical act and pre- and post-operative factors [6]. Appendectomy is the treatment of choice, and the use of the laparoscopic approach allows for faster post-operative recovery and reduces the risk of complications related to adhesions in the late post-operative period [7].

Laparoscopic appendectomy is the gold standard surgical procedure currently used for acute appendicitis. It is minimally invasive and has many advantages [8]. Laparoscopic appendectomy has shown significant advantages over open surgery, as it has the benefit of shorter hospital stays, less postoperative pain, a lower rate of complications after surgery and mortality, and lower costs [9].

Conventional appendectomy requires a larger abdominal incision, which is often associated with healing challenges and greater post-operative discomfort. In contrast, laparoscopic appendectomy, also known as minimally invasive surgery, represents a substantial advance by making it possible to approach through small incisions, through which a laparoscope and surgical instruments are inserted, giving the surgeon a clear and precise field of vision. This technique has shown significant advantages in terms of shorter recovery time, reduced incisional pain and superior aesthetic results [9].

The ASA classification proved to be a predictor of post-operative complications. As expected, since the ASA assesses the patient's preoperative condition, with a score that predicts morbidity and mortality and is one of the risk factors for surgical site infections. Similarly, surgical time and length of hospitalisation after surgery were significantly associated with the degree of complications [10] BECKER et al., [11] RUSHING et al., [12] MALAEKAH et al., [13] CIOFFI et al., [14] YI et al., [15], LI et al., [16], ZHIGANG, et al., [17].

## 2. MATERIALS AND METHODS

This research complies with the ethical precepts of the international standards of the Declaration of Helsinki, the Nuremberg Code and Resolution 466/2012 of the National Health Council. In addition, as this is a case report, the research was submitted to the Porto Dias Hospital Research Ethics Committee (CEP) and the Brazil Platform. It also had the acceptance of the supervisor, the acceptance of Porto Dias Hospital as the institution where the research took place, and was carried out after approval.

This is an observational, retrospective and descriptive study analysing medical records with a cross-sectional quantitative analysis of the complications of laparoscopic appendectomy. The data was collected by analysing patients who underwent videolaparoscopic appendectomy between January 2020 and January 2022, provided by the Porto Dias Hospital, located in the municipality of Belém, in the state of Pará.

The target population for the study was men and women who underwent laparoscopic appendectomy between January 2020 and January 2022 at Porto Dias Hospital. The total number of participants in the study was

confirmed only after contacting Porto Dias Hospital and after the study had been approved by the Research Ethics Committee. The monthly average of laparoscopic appendectomies performed at the institution was then requested, with the complications associated with the procedure duly analysed. At the time, the sample size was calculated using the sample calculation formula for a finite population of less than 10,000, in which the tolerable sampling error rate was 5%, with a 95% confidence rate.

This research was carried out by consulting the medical records system at Porto Dias Hospital, on patients who underwent laparoscopic appendectomy between January 2020 and January 2022. Pre-operative, peri-operative and post-operative aspects of appendectomy were assessed, involving epidemiological factors, bleeding, fistulas and the need for surgical re-approach. In addition, a review of the current literature on the subject was carried out in order to compare data found in the literature with the findings at Porto Dias Hospital.

Data was collected by searching the Virtual Health Library (VHL), US National Library of Medicine (PubMed) and Scientific Electronic Library Online (SciELO) platforms, using descriptors taken from the Descriptors in Science and Health (DeCS/MeSH) platform, in Portuguese or English: Postoperative Complications, Appendectomy, Video-Assisted Surgery and Video-Assisted Surgery, using the Boolean operator AND to connect them. Articles were selected that addressed the complications of laparoscopic appendectomies [11,12].

Data from all patients over the age of 18 who underwent laparoscopic appendectomy at Porto Dias Hospital between January 2020 and January 2022 were included. As for the bibliographic research, publications available on the BVS, SciELO and PubMed academic websites in English and Portuguese, with the aforementioned descriptors, published in the last 25 years, were analysed and included.

Data from patients under the age of 18, patients who underwent laparoscopic appendectomy outside the study period and patients whose medical records were incompletely filled out or who did not have the necessary information to carry out the research were excluded. Publications that were incomplete or unavailable in their entirety were excluded from the literature

search, as were publications with publication dates before 2000.

In order to distribute and analyse the data obtained in the research, they were added to graphs and tables in Microsoft Word 2020 and Microsoft Excel 2020, which facilitated careful quantitative analysis and better organisation of the results obtained. Subsequently, the results obtained were compared and debated in relation to the literature found on the subject according to the criteria already established in order to establish possible relationships between the variables found BECKER et al., [14], RUSHING et al., [15] MALAEKAH et al., [16] CIOFFI et al., [14] YI et al., [18] LI et al., [19] ZHIGANG, et al., [20].

The research will always be suspended if any physical, moral, psychological, social, spiritual, intellectual, ideological or cultural harm is detected to the researchers or patients during the research process and/or as a result of it. In addition, the research may also be paralysed due to any difficulties for reasons that are the responsibility of the Porto Dias Hospital. The data was organised using Microsoft Excel 2010. Graphs and tables were constructed using the tools available in the Microsoft Word, Excel and GraphPad Prism 9.0 programmes. All the tests were carried out using Bioestat 5.5 software. The qualitative variables were described using frequencies and percentages. 95% confidence intervals were calculated for the proportion to infer how the prevalence rates behaved in relation to the population from which they were obtained. Independence or association between two categorical variables was tested using the chi-square or Fisher's exact test, as appropriate, and significant associations were detailed using standardised residual analysis to identify the categories that contributed most to the result. Results with  $p \leq 0.05$  (two-sided) were considered statistically significant LAMM *et al.*, [18] GOUVEIA *et al.*, [19] DI SAVERIO *et al.*, [20] OLIVEIRA *et al.*, [3] FERRIS *et al.*, [5] MOREIRA *et al.*, [10].

### 3. RESULTS AND DISCUSSION

With regard to the results obtained in this research, in this session they were discussed in the light of comparison with similar existing findings and those contrary to the literature, based on an academic survey of the state of the art, as well as comparing the theoretical data that touches on the phenomena reported here with

that of other studies. Firstly, they were compared with the findings of other researchers who have exclusively investigated the complications associated with videolaparoscopic appendectomy; secondly, they were compared with the findings of studies with the profiles of the sample analysed, as well as with the methodology and objectives similar to those sought in this research. Finally, other types of signs and symptoms related to the post-surgical period of conventional and laparoscopic appendectomy found in this research were discussed with studies that elucidate and/or touch on them, in order to explain the data reported in the previous section of this research, but which had not been reported in the articles in this field of study. For this reason, the most accessible and relevant published works that contemplated and integrated the most prominent findings in the 3 categories addressed in this research were shown below: overview of the state of the art in the literature; analysis of the gender profile, age and characteristics of the surgical procedure of the sample and the association between factors related to complications and surgical findings.

### 4. OVERVIEW OF THE STATE OF THE ART IN LITERATURE

And by reviewing the relevant studies on laparoscopic appendectomies in the light of the objectives of this research, different perspectives emerge that contribute to a comprehensive understanding of the complications associated with this procedure. Birnbaum & Wilson [1] emphasised the effectiveness of the laparoscopic approach in their research, highlighting the reduction in recovery time. And with their optimistic view, they highlighted the minimisation of post-operative complications, providing a positive basis for the practice. In contrast to this perspective, Iamarino *et al.* [2] addressed the importance of careful patient selection, emphasising that the laparoscopic approach may not be indicated for all cases. And in their careful analysis, they recognised the possibility of complications in more complex situations, highlighting the need for individualised assessment for each case. Oliveira *et al.* [3] complemented this by emphasising the importance of the surgeon's experience when performing laparoscopic appendectomy. In their study, they emphasised that although the approach is safe in experienced hands, the learning curve can have an impact on complication rates. That's why they emphasised

the importance of adequate training to guarantee the safety of the procedure. Gutierrez *et al.* [4] offered a practical view by emphasising the importance of post-operative follow-up in the early identification of complications. In their research, they reinforced the importance of continuous surveillance, providing valuable insights for the prevention and effective management of any challenges. In addition, Ferris *et al.* [5] addressed the need for a comprehensive assessment of the clinical picture prior to laparoscopic appendectomy. They emphasised that proper patient selection and surgical planning are crucial to minimising intra- and post-operative complications. In addition, Sampaio & Dantas [6] brought a technical perspective, emphasising the benefits of laparoscopic appendectomy in terms of visualisation and manipulation. And the research's technical approach reinforced the efficacy of the surgical technique, in line with previous studies. In this vein, Cherif *et al.* [7] contributed a contemporary analysis, highlighting specific aspects related to laparoscopic appendectomy in varied contexts, as well as adding important nuances, recognising that different populations can present unique challenges. Porto *et al.* [8] and Ferreira *et al.* [9] offered learnings about standardised protocols and effective communication in preventing complications, and their research highlighted the importance of rigorous implementation of guidelines and collaboration between the surgical team. Moreira *et al.* [10] concluded their discussion with a critical analysis of complications, providing a comprehensive overview of the topic. And reinforcing the ongoing need for research and revision of protocols to improve results. Thus, when analysing the results of these studies, it emerged that laparoscopic appendectomy is generally effective and safe. However, careful patient selection, adequate training, comprehensive preoperative assessment and postoperative follow-up are crucial aspects for minimising complications. The technical approach, standardised protocols and collaboration between the surgical team also play a significant role in preventing challenges associated with this procedure.

## 5. CHARACTERISATION OF THE SAMPLE

A total of 437 records were included in the study. More than half (243 or 55.6%) of the patients were male. And 39.8% of the individuals were

between 20 and 39 years old at the time of the procedure, i.e. they were young adults (Table 1).

The characterisation of the sample in the studies by Birnbaum & Wilson [1] Iamarino *et al.* [2], Oliveira *et al.* [3], Gutierrez *et al.* [4], Ferris *et al.* [5], Sampaio & Dantas [6], Cherif *et al.* [7], Porto *et al.* [8] Ferreira *et al.* [9] and Moreira *et al.* [10] provided a comprehensive view of patients undergoing laparoscopic appendectomies.

In this study, 437 records were included, with a significant predominance of male patients, representing 55.6% of the total sample. The age range between 20 and 39 years was the most representative, corresponding to 39.8 per cent of cases, indicating that young adults frequently underwent this procedure. While the age distribution of patients in the laparoscopic appendectomies presented here has also been widely addressed in the different studies and corroborates the conclusions of the various authors analysed and who have discussed the prevalence of appendicitis in young adults and the preference for the laparoscopic approach in this specific group. However, when compared with the epidemiological data presented by Gutierrez *et al.* [4], who offered a more specific view of the northern region, it was possible to notice nuances in the characterisation of the sample. Their research highlighted a significant predominance of male patients, with an age distribution that may differ slightly from the national average, given the country's population diversity. It is therefore always important to consider these regional peculiarities when interpreting results, highlighting the relevance of geographical contextualisation when analysing post-appendectomy complications. In addition, the results presented by Sampaio & Dantas [6] added valuable information to the discussion, especially when they analysed specific data from a private hospital, which provided similar sociodemographic characteristics of patients in this specific environment, considering factors such as access to health services and socioeconomic profile. It should also be emphasised that, by integrating information from different studies, there is a convergence in the predominance of males in laparoscopic appendectomies. However, it is important to recognise that the surgical approach can vary according to the regional context, hospital structure and other determining factors.

**Table 1. Sociodemographic characteristics of patients undergoing appendectomy at Porto Dias Hospital (HPD), from January 2020 to January 2022, Belém-Pará**

Variable	Frequency	Percentage
<b>Sex</b>		
Female	193	44,2
Male	243	55,6
Not informed	1	0,2
<b>Age at Procedure</b>		
From 3 to 19 years old	67	15,3
From 20 to 39 years old	174	39,8
From 40 to 59 years old	135	30,9
From 60 to 86 years old	61	14,0

The percentages are relative to the total number of records (n=437)

With regard to age distribution, as can be seen in Table 1, the 20-39 age group stood out as the most frequent, which is in line with the medical literature on appendicitis, and the fact that the laparoscopic approach in this age group, which is more professionally productive, is commonly preferred due to its lower invasiveness and faster recovery, as well as the efficacy and safety of this technique in young adults (OLIVEIRA *et al.*, [3] FERRIS *et al.*, [5] MOREIRA *et al.*, [10]. That said, analysing the strands of various studies reflects the epidemiological trends of appendicitis mentioned above. However, a regional analysis; the particularities of private hospitals; and variations in surgical techniques further optimise understanding of the profile of patients undergoing laparoscopic appendectomy in the research context [9].

The majority (280 or 64.1%) of the sample had video surgery. Of these, 10.3% had complications. And only 4.6% (20 individuals) had an antibiotic change (Table 2). The confidence interval for prevalence (95% CI) indicates a range of values in which it is expected to find, for example, complications among patients, if a larger sample of people were obtained, with 95% certainty.

Analysing the idiosyncrasies of the procedure in laparoscopic appendectomies at the Porto Dias Hospital (HPD) revealed important nuances regarding the surgical approach and the occurrence of post-operative complications, since more than half of the patients underwent laparoscopic appendectomies, while just over 1/3 of the sample underwent the conventional procedure. And the predominance of the laparoscopic technique used corroborates the worldwide trend, reinforced by the findings of Sampaio & Dantas [6], who highlighted the growing preference for less invasive approaches.

However, divergences may arise when we analyse the data from Birnbaum & Wilson [1], showing variations in surgical practices over time and in different medical centres.

When it came to analysing complications, it was revealed that one tenth of the patients had some post-operative problem when undergoing laparoscopic appendectomy. These findings are in line with the medical literature, in which complication rates vary, and it is acceptable for a proportion of patients to face challenges during the post-operative period [5]. However, it is crucial to consider this differentiation between the different types of surgical techniques when interpreting how complications can vary even for the same therapeutic indication, as can be understood in the different types of surgeries in this research [10,5] At the same time, there was effective management of post-operative infections in the HPD, as antibiotic changes occurred in less than 5% of the cases analysed. These results are in line with the conclusions of Oliveira *et al.* [3] and Moreira *et al.* [10], who emphasised the importance of proper antibiotic administration to prevent infections. This suggests that the low incidences of antibiotic change in these studies may suggest that the prophylaxis practices adopted by the hospital are in line with recommended medical guidelines.

Furthermore, analysing the confidence interval (95%CI) allowed for a more comprehensive understanding of the estimates. However, it is essential to always interpret these intervals considering the sample size and possible regional or institutional variations [7] Thus, although the results are robust, their applicability in different contexts must be weighed up for each location, public and reality of care. And in comparison with the studies by Gutierrez *et al.*

[4]and Ferris et al. [5], which addressed specific complications of laparoscopic appendectomies, it was noted that this research contributed a more holistic view, especially when considering the variation of different variables in the same hospital. However, the relevance of more in-depth investigations into the specific complications reported here is emphasised, in order to further improve surgical practices. And so, by concatenating this information, it was realised that the discussion on the characteristics of the procedure in laparoscopic appendectomies is complex and multifaceted, since the variety of practices between hospitals, added to regional specificities, highlighted the need for a personalised approach in the evaluation and improvement of surgical techniques, so the constant dialogue between health professionals and the critical analysis of data contributed to a more grounded and efficient clinical practice IAMARINO et al., [2] GUTIERREZ et al., [4] FERRIS et al., [5] CHERIF et al., [7] PORTO et al., [8].

More than half (225 or 51.5%) of the patients were hospitalised for between 3 and 6 days. In addition, 191 individuals (43.7%) were hospitalised for up to 1 week (Table 3).

When examining the hospitalisation times and evolution of patients who underwent laparoscopic appendectomies at Porto Dias Hospital, an interesting variability in the results was evident, generating pertinent reflections for surgical practice. The majority of patients were hospitalised for between 3 and 6 days, according to the HPD records. And this information highlighted a consistency with the findings of Gutierrez et al. [4] and Ferris et al. [5], who also observed a similar hospital stay in their samples. However, this data contrasts with the research by Sampaio & Dantas [6], which indicated a trend towards shorter times, perhaps influenced by

specific protocols adopted at their institution. Analysing the evolution times after laparoscopic appendectomy revealed an interesting distribution. Almost half of the patients evolved favourably up to 1 week after the procedure, according to the HPD data. And these results corroborated the findings of Birnbaum & Wilson [1], Iamarino et al. [2], and Moreira et al. [10], who highlighted rapid recovery as a striking feature of laparoscopic appendectomy. However, the presence of cases with an evolution of up to 1 month highlighted the importance of considering possible late complications, a point confirmed by Ferris et al [5]. When comparing the different perspectives on hospitalisation times and evolution, it is essential to consider the particularities of each study. While some authors, such as Sampaio & Dantas [6], advocated rapid recovery protocols, others, such as Ferris et al [5], warned of the need for prolonged follow-up in order to identify any late complications more assertively. These variations in practices and outcomes in this and other studies have highlighted the complexity of clinical decision-making and the importance of considering the individual characteristics of each patient (FERREIRA et al., [9] MOREIRA et al., [10] IAMARINO et al., [2] GUTIERREZ et al., [4] FERRIS et al., [5]; CHERIF et al., [7] PORTO et al., [8]. In addition, analysing the demographic characteristics of patients undergoing laparoscopic appendectomy provided valuable insights for understanding the results of this study, since future research by this group also aims to explore the relationship between hospitalisation times and the age group of patients, considering the variation in recovery of different age groups. As advocated by authors such as Oliveira et al. [3], who are enthusiastic about this more integrated approach, especially as it allows for a more comprehensive and personalised view of surgical care. Thus,

**Table 2. Procedure characteristics of patients undergoing appendectomy at Hospital Porto Dias (HPD), from January 2020 to January 2022, Belém-Pará**

Variable	Frequency	Percentage	95%CI
<b>Type of Surgery</b>			
Conventional	157	35,9	31,5 - 40,6
Videolaparoscopic	280	64,1	59,4 - 68,5
<b>Complications</b>			
No	392	89,7	86,4 - 92,3
Yes	45	10,3	7,7 - 13,6
<b>Switching Antibiotics</b>			
No	417	95,4	92,9 - 97,1
Yes	20	4,6	2,9 - 7,1

Percentages are relative to the total number of records (n=437). 95%CI: 95% confidence interval for prevalence

**Table 3. Hospitalisation times and evolution of patients undergoing appendectomy at Hospital Porto Dias (HPD), from January 2020 to January 2022, Belém-Pará**

Variable	Frequency	Percentage
Length of Stay		
Less than 3 days	176	40,3
3 to 6 days	225	51,5
7 days or more	36	8,2
Evolution Time		
Up to 12 hours	72	16,5
Up to 24 hours	124	28,3
Up to 1 week	191	43,7
Up to 14 days	13	3,0
Up to 1 Month	3	0,7
> 1 Month	2	0,5
Not informed	32	7,3

The percentages are relative to the total number of records (n=437).

understanding hospitalisation and evolution times not only helps to optimise hospital management, but also directly influences the patient experience. And rapid recovery, as evidenced in the literature, can be a decisive factor in the choice of surgical technique, in line with patient expectations and needs. However, it is essential to recognise that each case is unique, and the individualisation of the clinical approach remains a fundamental principle [7].

That said, given the complexity of the scenario presented by the different studies, the synthesis of these findings has provided a solid basis for guiding post-surgical clinical practices. Mainly by integrating the perspectives of Birnbaum & Wilson [1], Iamarino *et al.*[2] Oliveira *et al.* [3], Gutierrez *et al.* [4], Ferris *et al.*[5], Sampaio & Dantas [6] Cherif *et al.* [7] Porto *et al.* [8] Ferreira *et al.* [9] and Moreira *et al.* [10]. a more holistic understanding of hospitalisation times and evolution in laparoscopic appendectomies was achieved, and that a comprehensive approach is always essential to underpin clinical practice and provide quality care, considering the diversity of medical scenarios and individual characteristics of each patient.

As for the surgical findings, 167 individuals (38.2%) had hyperemic and oedematous findings (Table 4).

Analysing the surgical findings in patients who underwent laparoscopic appendectomies, as shown in Table 4, revealed a variety of pathological manifestations that permeated the condition treated in this study. Among the most prevalent findings were the presence of hyperemia and oedema in more than 1/3 of the

cases. This is in line with the findings observed by Birnbaum & Wilson [1], who corroborated the results presented above by indicating that the most common finding was hyperaemia and oedema. However, it is interesting to note that the prevalence rate found in the sample in this study exceeded the percentage reported by Birnbaum & Wilson [1]. This discrepancy can be attributed to population variations, as well as technical improvements over the years, influencing the detection and recording of these conditions. Secondly, the presence of inflammatory fluid was identified in 30.7% of the cases, in line with the study by Gutierrez *et al.* [4]. suggesting consistency in the intraoperative manifestations found in this study, highlighting the usefulness of the videolaparoscopic approach for effective assessment of these anatomical details during surgery. The third most prevalent finding was fibrinous exudate (29.7%) and abscess (18.1%), which was also one of the most frequent findings, sharing similarities with studies by Ferris *et al.* [5] and Sampaio & Dantas [6]. The observation of these results shows consistency in the presentation of these pathological conditions with the scientific literature, suggesting common patterns in populations undergoing laparoscopic appendectomy. Notably, the presence of necrosis (14.2%) and perforation (8.9%) was noted, demonstrating the severity that some cases of appendicitis can reach, emphasising the importance of early diagnosis and intervention. These findings corroborate the observations of Cherif *et al.* [7] and Moreira *et al.* [10], who emphasised the diversity of presentations of acute appendicitis and the complexity associated with these cases. The occurrences of peritonitis (7.1 per cent), conversion to laparotomy (3.2 per



cent), retrocecal appendix (2.3 per cent) and pelvic adhesion (1.8 per cent) were less frequent but clinically relevant complications in this study. These results are in line with the findings of Porto *et al.* [8] and Ferreira *et al.* [9] indicating that although less prevalent, these outcomes have a significant impact on surgical management and patient prognosis. Finally, in the data analysed in Table 4, when they were classified as "other" (14.6%), it was because they required special attention, as they could cover a variety of conditions that did not fit into the pre-defined categories. And this broad category highlighted the complexity of the surgical scenario and the need for individualised assessment in certain situations. Therefore, when considering this

evidence, it is always imperative to emphasise the importance of an individualised approach in laparoscopic appendectomy, adapting to the nuances presented by each patient. The variations observed in surgical findings between studies have reinforced the need for a holistic assessment of the clinical picture, taking into account not only the nature of appendicitis, but also the specific characteristics of each patient [1-10].

As for complications, 44.4 per cent of individuals experienced vomiting, which was the most frequent (Table 5), followed by nausea (33.3 per cent) and abdominal pain (22.2 per cent).

**Table 4. Prevalence of surgical findings in patients undergoing appendectomy at Hospital Porto Dias (HPD), from January 2020 to January 2022, Belém-Pará**

Variable	Frequency	Percentage	95%CI
<b>Surgical Findings</b>			
Hyperemic and swollen	167	38,2	33,7 - 43,0
Inflammatory fluid	134	30,7	26,4 - 35,3
Fibrinous exudate	130	29,7	25,5 - 34,3
Abscess	79	18,1	14,6 - 22,1
Presence of necrosis	62	14,2	11,1 - 17,9
Drilling	39	8,9	6,5 - 12,1
Peritonitis	31	7,1	4,9 - 10,0
Conversion	14	3,2	1,8 - 5,4
Retrocecal appendix	10	2,3	1,2 - 4,3
Pelvic Adhesions	8	1,8	0,9 - 3,7
Others	64	14,6	11,5 - 18,4

Categories with fewer than 8 records are grouped under "other". Percentages are relative to the total number of records (n=437). 95%CI: 95% confidence interval for prevalence

**Table 5. Prevalence of complications in patients undergoing appendectomy at Porto Dias Hospital (HPD), from January 2020 to January 2022, Belém-Pará**

Variable	Frequency	Percentage	95%CI
<b>What Complication</b>			
Vomit	20	44,4	30,0 - 59,9
Nausea	15	33,3	20,4 - 49,1
Abdominal Pain	10	22,2	11,7 - 37,5
Abdominal distension	5	11,1	4,2 - 24,8
Collection	4	8,9	2,9 - 22,1
Abscess	3	6,7	1,7 - 19,3
Diarrhoea	3	6,7	1,7 - 19,3
Fever	3	6,7	1,7 - 19,3
Abscess	2	4,4	0,8 - 16,4
Headache	2	4,4	0,8 - 16,4
Constipation	2	4,4	0,8 - 16,4
Purulent secretion	2	4,4	0,8 - 16,4
Sepsis	2	4,4	0,8 - 16,4
Others	28	62,2	46,5 - 75,8

The percentages relate to individuals with complications from surgery (n=45). Categories with only one record are grouped under "other"

When addressing post-laparoscopic appendectomy complications, it was noted that vomiting was the most prevalent complication, affecting almost half of the patients, as shown in Table 5. And this high prevalence of vomiting can be associated with several factors, such as anaesthetic response, visceral manipulation during surgery and individual variations in postoperative recovery [2,1].

In line with the findings of Oliveira *et al.* [3] and Gutierrez *et al.* [4] the complications of nausea (33.3%) and abdominal pain (22.2%) stood out as frequently reported symptoms after videolaparoscopic appendectomy, and these symptoms reinforced the importance of immediate postoperative assessment for the effective management of these complications, ensuring the patients' adequate recovery. While abdominal distension (11.1%), collection (8.9%), abscess (6.7%), and diarrhoea (6.7%) emerged as less frequent complications, also in line with the findings of Ferris *et al.* [7] and Sampaio & Dantas [6]. Analysing this data implied the need for continuous monitoring of patients in the postoperative period, with special attention to the early identification of less common complications, which can significantly impact the postoperative course [2] In addition, other complications, grouped in the "other" category (62.2%), presented a wide range of less frequent events, indicating the complexity and heterogeneity of postoperative outcomes. This diversity was also observed in the studies by Cherif *et al.* [7] Porto *et al.* [8] Ferreira *et al.* [9] and Moreira *et al.* (2018), who stressed the importance of individualising post-surgical follow-up. According to the data analysis, fever (6.7%), abscess (4.4%), headache (4.4%), constipation (4.4%), purulent discharge (4.4%) and sepsis (4.4%) were the least common complications. The medical literature, represented by the studies consulted, emphasises the importance of clinical surveillance for the early detection of these events, allowing for immediate and appropriate intervention when necessary [6-10]. The complexity of laparoscopic appendix surgery was reflected in the various complications identified. Comparing the data with previous studies, there was consistency in the most frequent complications, while the heterogeneity of the less common complications highlighted the need for an individualised approach to postoperative assessment and management Gutierrez *et al.*, [4] Iamarino *et al.*, [2] Ferris *et al.*, [5] Birnbaum & Wilson, [1] Oliveira *et al.*, [3].

## 6. FACTORS RELATED TO COMPLICATIONS

Associations between the presence of complications and patient characteristics were then tested. Table 6 shows the association between complications, gender and age at procedure. For example, in the group without complications, more than half (222 or 56.8%) were male. In those with complications, more than half (24 or 53.3%) were female. However, these differences were not statistically significant ( $p=0.257$ ). Furthermore, age at the time of the procedure was not significantly associated with the presence of complications ( $p=0.457$ ).

When exploring the associations between the presence of complications after laparoscopic appendectomy and the sociodemographic characteristics of the patients. Table 6 shows that the distribution of complications did not differ significantly between the sexes. However, it was interesting to note that, despite not being statistically significant, the complication rate was slightly higher in the female group, a finding that contrasted with the majority of studies that often point to a lower prevalence of complications among women [2]. As for age, no statistically significant association was found between the age group of patients and the presence of complications, as also confirmed by Oliveira *et al.* [3]. These results indicated a relative homogeneity in the distribution of complications between the different age groups, partly contradicting the trend identified by Gutierrez *et al.* [4] who, in their research, observed a higher incidence of complications in younger patients.

The individualised approach to laparoscopic surgery was once again corroborated by the findings of this analysis, which always reinforces the importance of a holistic clinical assessment. From this, it was observed that, despite the trends presented in the literature, the correlation between sociodemographic characteristics and complications in laparoscopic appendectomies was multifactorial and may vary in different clinical contexts [5] And the findings of Sampaio & Dantas [6], Cherif *et al.* [7], Porto *et al.* (2023), Ferreira *et al.* [9] and Moreira *et al.* (2018) offered additional insights, indicating the need for more comprehensive investigations into specific risk factors for each of the complications found, in line with the analysis of this study. The heterogeneity of results between these studies and our research highlighted the complexity of this relationship and pointed to the relevance of

**Table 6. Relationship between the presence of complications and sociodemographic characteristics of patients undergoing appendectomy at Porto Dias Hospital (HPD), from January 2020 to January 2022, Belém-Pará**

Variable	Without (n=391)	Complications With (n=45)	p-value
<b>Sex</b>			0,257
Female	169 (43,2)	24 (53,3)	
Male	222 (56,8)	21 (46,7)	
<b>Age at Procedure</b>			0,457
From 3 to 19 years old	57 (14,5)	10 (22,2)	
From 20 to 39 years old	160 (40,8)	14 (31,1)	
From 40 to 59 years old	121 (30,9)	14 (31,1)	
From 60 to 86 years old	54 (13,8)	7 (15,6)	

*Categorical variables are shown as n (%). The percentages are relative to the total of each column. The chi-square test was used in all cases*

**Table 7. Relationship between the presence of complications and the characteristics of the procedure in patients undergoing appendectomy at the Porto Dias Hospital (HPD), from January 2020 to January 2022, Belém-Pará**

Variable	Without (n=392)	Complications With (n=45)	p-value
<b>Type of Surgery</b>			<0,001 <sup>1</sup>
Conventional	130 (33,2) *	27 (60,0) †	
Videolaparoscopic	262 (66,8) †	18 (40,0) *	
<b>Switching Antibiotics</b>			<0,001 <sup>2</sup>
No	386 (98,5) †	31 (68,9) *	
Yes	6 (1,5) *	14 (31,1) †	

*Categorical variables are shown as n (%). Percentages are relative to the total of each column. <sup>1</sup>Chi-squared test. <sup>2</sup>Fisher's Exact Test. \*: this frequency was lower than would be expected by chance. †: this frequency was higher than expected*

personalising surgical strategies based on patient characteristics. Therefore, the findings here suggested that the relationship between the presence of complications and sociodemographic characteristics in laparoscopic appendectomies is more subtle and multifaceted than often portrayed in the literature and the lack of statistically significant correlations does not negate the need for an individualised approach, but rather highlighted the importance of considering different factors when planning and performing laparoscopic appendectomy surgery (SAMPAIO & DANTAS, 2022).

There was a significant association between complications and the type of surgery ( $p < 0.001$ ): of the 45 individuals with complications, 60 per cent had conventional surgery, a higher proportion than expected; of the individuals without complications, 66.8 per cent had video surgery, a higher proportion than expected by the statistical test. There was also a significant

association between the presence of complications and antibiotic change ( $p < 0.001$ ): of the 392 individuals without complications, 98.5 per cent had no antibiotic change, this proportion being higher (†) than expected; of the individuals with complications, 31.1 per cent had an antibiotic change, this proportion being higher than expected by the statistical test (†) (Table 7). To summarise, conventional surgery and antibiotic change were significantly associated with the presence of complications.

Analysing these results in comparison to studies on factors related to complications in laparoscopic appendectomies, there was unanimity regarding the significant association between the type of surgery and the presence of complications [1]. The results in Table 7 reveal a higher rate of complications in conventional surgeries, in contrast to the lower rate in video procedures (40.0%). This data was consistent with the literature, reinforcing that the surgical approach adopted was a determining factor for

the outcome of the intervention [2]. Another relevant point was the influence of changing antibiotics on the occurrence of postoperative complications, as in the findings of Oliveira *et al.* [3]. The analysis in Table 7 showed that the change of antibiotics was significantly correlated with complications ( $p < 0.001$ ). Of the patients with complications, almost 1/3 underwent antibiotic change, while only 1.5% of those without complications underwent this procedure. These findings suggest the importance of an appropriate antibiotic strategy in preventing complications, corroborating Gutierrez *et al.* [4]. However, it is still essential to mention nuances identified in recent studies. Such as those by Sampaio & Dantas [6] and Cherif *et al.* [7] which brought to light variations in the correlation between type of surgery and complications. These authors suggested that, in certain clinical contexts, the relationship between complications and type of surgery may not be as clear as the data suggests, highlighting the complexity of the issue and the need to consider individual variables when making surgical decisions [5]. Furthermore, the influence of antibiotic switching was debated by Porto *et al.* (2023) and Ferreira *et al.* [9], who differed in terms of its relevance as a risk factor for complications. While the research by Porto *et al.* (2023) suggested a significant association, Ferreira *et al.* [9] indicated a lower proportion of antibiotic changes in cases of complications. These discrepancies can be attributed to differences in institutional protocols and the specific characteristics of the population studied.

In line with the literature, the analysis of this study also highlighted the complexity of the relationship between the presence of complications and the characteristics of the procedure in laparoscopic appendectomies. These findings emphasise the need for an approach that takes into account clinical variables, as well as the particularities of the patient and the surgical environment (SAMPAIO & DANTAS, [6] MOREIRA *et al.*, 2018). However, based on these data, when compared with the state of the surgical technique in the literature, it is still questionable, as a prospect for future research, to explore other factors that may contribute to complications in laparoscopic appendectomies, such as individual anatomical characteristics and specific conditions of the appendix. Prospective studies can provide a more dynamic view of these associations, allowing for a more comprehensive analysis over time (GUTIERREZ *et al.*, [4] FERRIS *et al.*, [5].

There was a significant association between complications and length of stay ( $p < 0.001$ ): of the individuals without complications, 44.6% had a length of stay of less than 3 days, this proportion being higher ( $\dagger$ ) than expected; of the individuals with complications, 51.1% had a length of stay of 7 days or more, this proportion being higher than expected by the statistical test ( $\dagger$ ). There was a significant association between complications and length of stay ( $p = 0.017$ ): in the group with complications, 70.7 per cent were hospitalised for up to 1 week, a higher proportion than expected (Table 8).

**Table 8. Relationship between the presence of complications and length of stay and evolution of patients undergoing appendectomy at Porto Dias Hospital (HPD), January 2020 to January 2022, Belém-Pará**

Variable	Without (n=392)	Complications	With (n=45)	Complications	p-value
<b>Length of Stay</b>					<0,001
Less than 3 days	175 (44,6) $\dagger$		1 (2,2)*		
3 to 6 days	204 (52,0)		21 (46,7)		
7 days or more	13 (3,3)*		23 (51,1) $\dagger$		
<b>Evolution Time</b>					0,017
Up to 12 hours	69 (19,0)		3 (7,3)		
Up to 24 hours	116 (31,9)		8 (19,5)		
Up to 1 week	162 (44,5)*		29 (70,7) $\dagger$		
Up to 14 days	13 (3,6)		0 (0,0)		
> 14 Days	4 (1,1)		1 (2,4)		

Categorical variables are shown as n (%). The percentages are relative to the total of each column. The chi-square test was used in all cases. \*: this frequency was lower than would be expected by chance.  $\dagger$ : this frequency was higher than expected

When we analyse the results in table 8, we see a significant relationship between complications and length of hospital stay, showing an association between these variables ( $p < 0.001$ ). Almost half of the individuals without complications had a length of stay of less than 3 days, while those with complications, in just over half of the cases, showed a tendency towards longer stays, remaining in hospital for 7 days or more. This finding, when compared with the literature, suggested that complications increased the need for a longer recovery period [1].

The results also revealed a statistically significant relationship with the presence of complications ( $p = 0.017$ ). Patients with complications, notably, had a higher frequency of evolution up to 1 week (70.7 per cent). In contrast, those without complications showed a more equitable distribution in the different time intervals. This association emphasised the influence of complications on postoperative evolution, suggesting that patients with complications tend to have a longer recovery, similar to the findings of Lamarino *et al.* [2]. In addition, significant differences between the groups in terms of length of stay and outcome, depending on the presence of complications, also corroborated previous findings by Oliveira *et al.* [3] and Gutierrez *et al.* [4]. These studies also observed a direct relationship between complications and unfavourable post-operative outcomes. However, it is important to mention that the definition of complications can vary between studies, which highlights the importance of standardising the criteria for assessment.

In line with the literature, the data suggested that the early identification of complications can have a positive impact on the length of stay and evolution of patients, since effective postoperative monitoring strategies, combined with timely interventions in the face of identified complications, can contribute to a faster recovery and a reduction in prolonged hospitalisations [5].

The results presented here were consistent with the findings of Sampaio & Dantas [6] and Cherif *et al.* [7], who also highlighted the relationship between complications and unfavourable outcomes. These authors reinforced the importance of careful post-operative follow-up to optimise the management of complications and, consequently, reduce the negative impacts on length of stay and evolution. However, disagreements were identified in the studies by

Porto *et al.* (2023) and Ferreira *et al.* [9], who differed in terms of the significant influence of complications on the length of hospital stay and evolution. These discrepancies can be attributed to methodological and sampling differences, indicating the need for a more in-depth analysis for a comprehensive understanding of these associations.

Analysing these results has highlighted the intrinsic relationship between complications, length of stay and postoperative evolution in laparoscopic appendectomies. Understanding these interactions has become fundamental to improving surgical practice and developing strategies aimed at the effective prevention and management of complications, which have a positive impact on patient recovery Ferris *et al.*, [5] oliveira *et al.*, [3] gutierrez *et al.*, [4], sampaio & dantas, [6] cherif *et al.*, [7].

Table 9 shows the association between the presence of complications and surgical findings. There was a significantly higher proportion of cases of complications in the surgical findings of abscess ( $p < 0.001$ , 47.6 per cent of the group with complications had this finding while only 16.2 per cent of the patients without complications had it), perforation ( $p < 0.001$ , 31 per cent of the group with complications had this finding while only 7.1 per cent of patients without complications did), peritonitis ( $p = 0.009$ , 19 per cent of the group with complications had this finding while only 6.3 per cent of patients without complications did) and conversion ( $p = 0.009$ , 11.9 per cent of the group with complications had this finding while only 2.5 per cent of patients without complications did). With regard to the finding that represented the hyperemic and oedematous profile, the trend was reversed: this finding was significantly more common among patients without complications ( $p = 0.001$ ).

Analysing the final results of this research into complications of laparoscopic appendectomies revealed relevant patterns in the relationship between surgical findings and the presence of complications. Table 9 shows the significant associations between complications and specific findings. It was noted that cases of abscess, perforation, peritonitis and conversion had significantly higher proportions in patients with complications compared to those without. These results are in line with the study by Birnbaum & Wilson [1] who emphasised the importance of these findings as predictors of post-operative complications. Surprisingly, the finding of a

hyperemic and oedematous appendix was significantly more prevalent among patients without complications. This trend reversal, highlighted in Table 9, was interesting, especially in light of the research by Sampaio & Dantas [6], who discussed the possibility of different macroscopic presentations of the appendix and their relationship with complications. These findings also suggest that the presence of macroscopic inflammatory signs is not always directly associated with post-surgical complications. At the same time, analysing the presence of necrosis revealed no significant association with complications. This neutrality contrasted with the results of Ferris *et al.* [5], who emphasised the relationship between necrosis and complications. However, the lack of statistical significance may indicate a need to consider additional factors when assessing necrosis as a predictor of complications in

laparoscopic appendectomies. Perforation, a key surgical finding, showed a significant association with complications, corroborating similar findings in other studies, such as Gutierrez *et al.* [4] And the presence of perforation was consistently pointed out as a marker of greater risk of complications, emphasising the importance of early detection of this finding during surgical intervention. Regarding the presence of adhesions and other anatomical characteristics, Table 9 showed no significant association with complications. These results diverge from the conclusions of Porto *et al.* (2023) and Ferreira *et al.* [9], who associated adhesions with an increase in post-operative complications. Emphasising that the absence of statistical correlation in this study suggested that, although adhesions are clinically relevant, their isolated presence may not be a determining factor in the development of complications.

**Table 9. Relationship between the presence of complications and surgical findings in patients undergoing appendectomy at the Porto Dias Hospital (HPD), from January 2020 to January 2022, Belém-Pará**

Variable	Without Complications (n=364)	With Complications (n=42)	p-value
<b>Hyperemic and swollen</b>			0,001 <sup>1</sup>
No	204 (56,0)*	35 (83,3)†	
Yes	160 (44,0)†	7 (16,7)*	
<b>Inflammatory fluid</b>			0,207 <sup>1</sup>
No	248 (68,1)	24 (57,1)	
Yes	116 (31,9)	18 (42,9)	
<b>Fibrinous exudate</b>			0,986 <sup>1</sup>
No	248 (68,1)	28 (66,7)	
Yes	116 (31,9)	14 (33,3)	
<b>Abscess</b>			<0,001 <sup>1</sup>
No	305 (83,8)†	22 (52,4)*	
Yes	59 (16,2)*	20 (47,6)†	
<b>Presence of necrosis</b>			0,345 <sup>1</sup>
No	311 (85,4)	33 (78,6)	
Yes	53 (14,6)	9 (21,4)	
<b>Drilling</b>			<0,001 <sup>2</sup>
No	338 (92,9)†	29 (69,0)*	
Yes	26 (7,1)*	13 (31,0)†	
<b>Peritonitis</b>			0,009 <sup>2</sup>
No	341 (93,7)†	34 (81,0)*	
Yes	23 (6,3)*	8 (19,0)†	
<b>Conversion</b>			0,009 <sup>2</sup>
No	355 (97,5)†	37 (88,1)*	
Yes	9 (2,5)*	5 (11,9)†	
<b>Retrocecal appendix</b>			0,074 <sup>2</sup>
No	357 (98,1)	39 (92,9)	
Yes	7 (1,9)	3 (7,1)	
<b>Pelvic Adhesions</b>			0,196 <sup>2</sup>

Variable	Without Complications (n=364)	With Complications (n=42)	p-value
No	358 (98,4)	40 (95,2)	
Yes	6 (1,6)	2 (4,8)	
<b>Epiplon adhesion</b>			1,000 <sup>2</sup>
No	360 (98,9)	42 (100,0)	
Yes	4 (1,1)	0 (0,0)	
<b>Adherence</b>			1,000 <sup>2</sup>
No	361 (99,2)	42 (100,0)	
Yes	3 (0,8)	0 (0,0)	
<b>Subserous appendix</b>			1,000 <sup>2</sup>
No	361 (99,2)	42 (100,0)	
Yes	3 (0,8)	0 (0,0)	
<b>Appendicolite</b>			1,000 <sup>2</sup>
No	361 (99,2)	42 (100,0)	
Yes	3 (0,8)	0 (0,0)	
<b>Wing Locking</b>			0,280 <sup>2</sup>
No	362 (99,5)	41 (97,6)	
Yes	2 (0,5)	1 (2,4)	
<b>Epiplon blockade</b>			1,000 <sup>2</sup>
No	361 (99,2)	42 (100,0)	
Yes	3 (0,8)	0 (0,0)	
<b>Cecorraphy</b>			0,280 <sup>2</sup>
No	362 (99,5)	41 (97,6)	
Yes	2 (0,5)	1 (2,4)	
<b>Tubo-Ovarian Abscess</b>			0,196 <sup>2</sup>
No	363 (99,7)	41 (97,6)	
Yes	1 (0,3)	1 (2,4)	
<b>Small Intestine Adhesion</b>			1,000 <sup>2</sup>
No	362 (99,5)	42 (100,0)	
Yes	2 (0,5)	0 (0,0)	
<b>Loose grip</b>			1,000 <sup>2</sup>
No	362 (99,5)	42 (100,0)	
Yes	2 (0,5)	0 (0,0)	
<b>Blocking</b>			0,196 <sup>2</sup>
No	363 (99,7)	41 (97,6)	
Yes	1 (0,3)	1 (2,4)	
<b>Ovarian Cyst</b>			1,000 <sup>2</sup>
No	362 (99,5)	42 (100,0)	
Yes	2 (0,5)	0 (0,0)	
<b>Faecalith</b>			1,000 <sup>2</sup>
No	362 (99,5)	42 (100,0)	
Yes	2 (0,5)	0 (0,0)	
<b>Umbilical Hernia</b>			1,000 <sup>2</sup>
No	362 (99,5)	42 (100,0)	
Yes	2 (0,5)	0 (0,0)	
<b>Presence of a tumour</b>			1,000 <sup>2</sup>
No	362 (99,5)	42 (100,0)	
Yes	2 (0,5)	0 (0,0)	

Categorical variables are shown as n (%). Percentages are relative to the total of each column. <sup>1</sup>Chi-squared test. <sup>2</sup>Fisher's Exact Test. \*: this frequency was lower than would be expected by chance. †: this frequency was higher than expected

However, it should be emphasised that the interpretation of these results must take into account the limitations of the study, such as its retrospective design and sample size. Despite this, the study provided a comprehensive overview of complications in laparoscopic appendectomies, contributing to an understanding of the factors associated with this outcome. That said, analysing surgical findings and their relationship with complications in laparoscopic appendectomies highlighted the importance of identifying early signs such as abscess, perforation and peritonitis [6]. The inverse relationship between hyperaemia and oedema and complications revealed the complexity of the clinical presentation of the appendix [9]. These results have contributed to an understanding of the variables that can influence the post-operative outcome and have provided support to further improve this surgical approach [1].

## 7. CONCLUSION

In the context of videolaparoscopic appendectomy surgery, this research promoted a detailed immersion in the factors related to complications, outlining a comprehensive panorama and making a significant contribution to the state of the art in this specific area. The objectives outlined, which involved analysing the state of the art in the literature, investigating the gender profile, age and characteristics of the surgical procedure in the sample, and observing the association between factors and surgical findings, were meticulously achieved. And when considering the demographic profile of the sample, it stands out that more than half of the patients were male, and a significant proportion comprised young adults, aged between 20 and 39. This information provides a crucial contextual overview, allowing us to learn about possible variations in complications between different age and gender groups. With regard to surgical procedures, it was observed that the majority were conducted using the video technique, corroborating the current trend. The analysis of these data, together with the findings of complications, highlighted that the conventional surgery technique was significantly associated with an increase in complications, signalling the need for careful considerations when selecting the surgical approach. As for the complications, such as vomiting, nausea and abdominal pain, they outlined a relevant symptomatological profile, providing health professionals with knowledge about the post-operative aspects to

be monitored. The association between antibiotic change and complications also reinforced the importance of proper management of antimicrobial therapies in post-operative management, with direct implications for clinical practice. Furthermore, when investigating the temporal relationship, significant associations were identified between complications, length of hospitalisation and length of evolution. Notably, patients with complications had a higher prevalence of prolonged hospitalisation and longer evolution. These findings have direct implications for post-operative management strategies, highlighting the need for intensive monitoring in susceptible cases. Furthermore, the analysis of surgical findings revealed significant associations with complications, especially in cases of abscess, perforation, peritonitis and conversion, supporting the importance of early identification of these findings during the surgical procedure in order to anticipate possible post-operative complications. Therefore, the results of this study provided a comprehensive overview of the factors associated with complications in laparoscopic appendectomies, emphasising the ongoing need to improve surgical practices. Understanding these elements contributes not only to the evolution of scientific knowledge in the area, but also guides more effective clinical strategies, promoting a personalised, patient-centred approach to appendix surgery in the northern region.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

As per international standard or university standards written ethical approval has been collected and preserved by the author(s).

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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- DOI:10.1007/s00464-023-10456-5  
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