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The impact of laparoscopic surgery on postoperative pain: A prospective study

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Abstract

Introduction: The reduction of postoperative pain intensity is recognized as one of the major advantages of laparoscopic surgery. However, even though this pain is of low intensity, it is not completely abolished after laparoscopic surgery, and may even be multifactorial in origin. The objective of our study is to evaluate pain after laparoscopic surgery and to highlight the various causes of pain.

Materials and Methods: This is a descriptive and prospective study involving 337 patients undergoing laparoscopic surgery for non-traumatic acute abdominal emergencies between February 2018 and October 2021. Pain was assessed using the visual analog scale (VAS).

Results: Postoperative pain was present in 335 patients (99.4%) on postoperative day 0 and in 283 patients (83.98%) on postoperative day 1. This pain was of low intensity in the majority of cases (73%, n=246 patients) on postoperative day 0 and (68.5%, n=231 patients) on postoperative day 1. Surgical site pain was present in 134 cases (39.77%), pain related to delayed intestinal transit in 52 cases (15.43%), shoulder pain related to CO2 in 40 cases (11.87%), and a combination of different types of pain was found in 16.7% of patients.

Conclusion: Post-laparoscopic surgery pain is multifactorial, of low intensity, and easily managed with first-tier analgesics.

Keywords: Pain; Postoperative Pain; Shoulder Pain; Spastic Ileus; Laparoscopy.

1. Introduction

The advantages of laparoscopy are manifold, including reduced hospital stay, rapid return to socio-professional activities, and improved cosmetic outcomes [1-4]. Another major advantage of laparoscopic procedures, compared to conventional surgery, is the reduction in postoperative pain [5-8]. Often, laparoscopy is associated with low-intensity pain, facilitating rapid postoperative rehabilitation for patients. The absence of large incisions and parietal trauma results in fewer nerve injuries and reduces the occurrence of significant parietal suppuration, partly explaining the low intensity of pain after laparoscopic surgery.

However, even though the pain is mild, it is not completely abolished after laparoscopic surgery, and it is multifactorial in origin [5]. Among the factors implicated in the genesis of pain following laparoscopic surgery are pain at the surgical site (pain at trocar insertion sites and pain at the operated organ site), pain related to paralytic ileus (delayed transit resumption), and specific shoulder pain associated with laparoscopic approach [5].

The objective of our study is to evaluate pain after laparoscopic surgery and elucidate the various causes of pain.

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2. Materials and Methods

Conducted at the academic department of general surgery at Ain Taya Hospital (CHU Alger EST, Algeria), our descriptive and prospective study included 337 patients undergoing laparoscopic surgery for non-traumatic acute abdominal emergencies between February 2018 and October 2021.

We included in this study all adult patients aged 15 years and older presenting solely with non-traumatic acute abdominal surgical emergencies.

We excluded from this study traumatic emergencies, patients classified as ASA IV, and patients in hypovolemic or septic shock states.

Postoperative pain was assessed at postoperative day 0 (POD0) and postoperative day 1 (POD1) using the visual analog scale (VAS) and classified into four categories:

No pain = VAS 0,

Mild pain = (VAS 0 – 3),

Moderate pain = (VAS 4 – 6),

Severe pain = (VAS > 6).

In our study, we employed first-tier analgesics as the initial approach (paracetamol). The majority of our patients were discharged on POD1; therefore, pain intensity assessment was conducted at POD0 and POD1.

Evaluation of the duration of postoperative pain was performed during follow-up consultations.

3. Results

Among the 337 operated patients, 178 (53%) had appendicitis, 88 (25.9%) had acute cholecystitis, 27 (7.5%) had adnexal torsion, 24 (6.9%) had ectopic pregnancies, 10 (3%) had peptic ulcer perforations, 08 (2.4%) had intestinal obstructions due to adhesions, and 07 (2.1%) had nonspecific acute abdominal pain. We observed a female predominance of 56.4%, with a mean age of 38 years ± 15 years (range 15-82 years). The body mass index (BMI) was above 25 in 179 patients (53.11%). Comorbidities were present in 109 patients (32.3%), and scarred abdomen was present in 90 patients (26.7%). Our patients were classified as ASA I in 74.8% (252 patients), ASA II in 22% (74 patients), and ASA III in 3.3% (11 patients). Pregnant women represented 4.2% (08 patients) of our sample, with a mean gestational age of 15 weeks of amenorrhea (WA) ± 07.29 WA (range from 07 WA to 29 WA).

The mean operative time for all pathologies combined was 52.09 minutes ± 24.14 minutes (range: 14 minutes to 178 minutes). The overall anesthesia duration (surgical intervention duration) was 75.35 minutes ± 25.17 minutes (range: 29 minutes to 203 minutes).

The mean overall hospitalization duration was 1.5 days (range: 1 day to 8.5 days), and the mean postoperative hospitalization duration was 01 day (range: 01 day to 7.5 days).

The postoperative morbidity rate was 6.2% (n = 21 patients).

Postoperative pain was present in 335 patients (99.4%) on postoperative day 0 (POD0) and in 283 patients (83.98%) on postoperative day 1 (POD1). This pain was of low intensity in the majority of cases (73%, n=246 patients) on POD0 and (68.5%, n=231 patients) on POD1.

This pain evolved by regressing in all cases. Indeed, the follow-up of pain evolution between POD0 and POD1 shows that: 246 (73%) patients had low-intensity pain on POD0 versus 231 (68.5%) patients had low-intensity pain on POD1. 83 (24.6%) had moderate-intensity pain on POD0 versus 50 (14.8%) patients had moderate-intensity pain on POD1. 06 patients (1.78%) had severe-intensity pain on POD0 versus 02 patients (0.6%) had severe-intensity pain on POD1. 02 (0.6%) patients had no pain on POD0 versus 54 (16.2%) patients had no pain on POD1.

The average duration of pain was 1.99 days ± 1.09 days with extremes ranging from 0 days to 06 days.

Surgical site pain (pain at incision points and pain at the site of the operated organ) is the main cause of postoperative pain (49.2%).

Specific shoulder pain associated with laparoscopic approach was found in 73 patients (21.6%).

Table 1 Origin of Postoperative Pain

Origin of Postoperative Pain	**Fréquence**	**Pourcentage**
Surgical Site Pain	134	39.77 %
Pain Associated with Non-resumption of Intestinal Transit	52	15.43 %
CO2-Related Shoulder Pain	40	11.87 %
Surgical Site Pain + Pain Associated with Non-resumption of Intestinal Transit	24	7.1 %
Shoulder Pain + Pain Associated with Non-resumption of Intestinal Transit	23	6.82 %
Surgical Site Pain + CO2-Related Shoulder Pain	10	03 %
Total	283	84 %

Using appropriate statistical tests such as the Chi-square test (χ^2), Spearman's rank correlation, and Fisher's exact test, we investigated potential risk factors for postoperative pain, including sex, age, body mass index (BMI), ASA classification, operated pathology, topography of the operated organ (above or below the mesocolon), operative time, drainage, and day of resumption of intestinal transit. Positive results were summarized in Table 02:

Table 2 Summary of Significant Correlations between Various Parameters and Postoperative Pain

Parameters	**Intensity of Pain**		**Durée de la douleur**
	Postoperative Day 0(POD 0)	Postoperative Day 1 (POD 1)	
Gender	/	/	/
Age	p : 0,042	/	R= 0,032, p = 0,556,
Body Mass Index (BMI)	/	/	/
ASA Physical Status Classification	/	p : 0,013	/
Operated Pathology	p : 0,039	/	/
Location of Operated Organ	p : 0,049	/	/
Operative Time	p : 0,017	p : 0,012	R= 0,137, p value= 0,006
Use of Drainage at the end of surgery	/	/	/
Day of Resumption of Intestinal Transit	R= 0,202, p : 0,001	R=0,188, p : 0,001	R =0,202, p : 0,001

The threshold of operative time at which pain begins to appear is 34.5 minutes (Youden's test)

4. Discussion

In our series, postoperative pain was present in 283 patients (84%) on postoperative day 1 (POD1). Most commonly (134 patients = 39.77%), it was surgical site pain (pain at incision sites and intra-abdominal pain depending on the operated organ). Specific shoulder pain related to laparoscopic approach was found in 11.87% of cases.

The intensity of postoperative pain in our series was low (VAS = 0-3) in 73% on POD0 and 68.5% on POD1. This pain evolved by regressing, with an average duration of 1.99 days (range from 0 days to 06 days).

Using appropriate statistical tests (Chi-square test, Spearman's rank correlation, and Fisher's exact test), we investigated risk factors for postoperative pain such as sex, age, body mass index (BMI), ASA classification, operated pathology, topography of the operated organ (above or below the mesocolon), operative time, drainage, and day of resumption of intestinal transit. The results are as follows:

There is a significant relationship between the intensity of postoperative pain on POD0 and age (p-value = 0.042, Chi-square test). Pain is more intense in subjects under the age of 40 on POD0. Furthermore, there is a significant relationship between the duration of postoperative pain in days and age (R= 0.032, and p-value = 0.556, Spearman's rank correlation test). Due to the relatively young age mean of our population (mean age = 38 years ± 15 years), the lack of psychological preparation in younger patients for emergency surgical intervention could explain this relationship between the intensity and duration of postoperative pain and age.

There is a significant relationship between the intensity of postoperative pain on POD1 and ASA classification (p-value = 0.013, Chi-square test). Pain is more intense in patients classified as ASA II and ASA III. None of the patients classified as ASA I experienced severe-intensity pain. The impaired immune defenses in patients classified as ASA II and ASA III due to their comorbidities may potentially expose these patients to increased sensitivity to pain.

There is a relationship between the intensity of postoperative pain on POD0 and the operated pathology (p-value = 0.039, Chi-square test). The intensity of pain is higher in patients operated for acute appendicitis and lithiasic acute cholecystitis. This could be explained by the significant local-regional inflammation caused by these pathologies, the section of some nerve fibers contained within the mesoappendix (during appendectomies), and the subhepatic region (Calot's triangle and the gallbladder bed during cholecystectomies), and finally, the sometimes intense use of gallbladder bed coagulation for hemostasis leading to significant postoperative inflammatory reactions. Additionally, there is a significant relationship between the duration of pain in days and the operated pathology. Peritonitis due to peptic ulcer perforation, generalized appendicular peritonitis, and acute intestinal obstructions due to adhesions are the pathologies where postoperative pain lasts longer. The generalized peritoneal syndrome caused by these pathologies and the resulting generalized inflammatory reactions could explain the prolongation of postoperative pain over time.

There is a relationship between the intensity of postoperative pain on POD0 and the location of the operated organ (p-value = 0.049, Chi-square test). The intensity of postoperative pain is higher in patients operated on an organ located below the mesocolon. The multiplicity of pathologies at this level, and their often septic nature (presence of necrosis during acute appendicitis and adnexal torsions), could be responsible for postoperative inflammatory reactions explaining the intensity of postoperative pain.

There is a relationship between the intensity of pain on POD0 and POD1 and the operative time (p-value = 0.017 on POD0 and p-value = 0.012 on POD1, Spearman's rank correlation test). Pain intensity increases with prolonged operative time. The threshold of operative time at which pain begins to appear is 34.5 minutes (Youden's test). There is a significant correlation between the duration of pain and operative time (R= 0.137, p-value= 0.006, Spearman's rank correlation test). The longer the operative time, the more prolonged the postoperative pain will be.

Abdominal distension resulting from pneumoperitoneum creation leads to ischemia of the abdominal wall nerves (stretching of these nerves and their prolonged tension). Prolonged irritation of the abdominal wall nerves by insufflated CO2 could explain the relationship between prolonged operative time and increased pain intensity. Moreover, prolonged operative time often indicates a laborious pathology, thus leading to significant inflammatory reactions, which could also explain the relationship between prolonged operative time and high intensity of postoperative pain. The correlation between operative time and the duration of postoperative pain can likely be explained by the time it takes for the nerves (stretched and ischemic due to prolonged abdominal distension) to return to a normal state.

There is a relationship between the intensity of pain on POD0 and POD1 and the day of resumption of intestinal transit (R= 0.202, p-value = 0.001 on POD0 and R=0.188, p-value = 0.001 on POD1, Spearman's rank correlation test). Pain intensity increases with delayed resumption of intestinal transit. There is also a significant correlation between the duration of postoperative pain and the day of resumption of intestinal transit (R =0.202, p-value = 0.001, Spearman's rank correlation test). This pain is explained by colic resulting from gas movements in the intestinal lumen.

The randomized study by JEW van Dijk [1] demonstrates that the genesis of post-laparoscopic surgery pain is multifactorial: pain at the parietal incision sites is found in 93% to 99% of cases, intra-abdominal pain is found in 68% to 71% of cases, and shoulder pain in 46% to 55% of cases.

In our series, site-specific pain is present in 134 cases (39.77%), pain related to non-resumption of intestinal transit in 52 cases (15.43%), CO2-related shoulder pain in 40 cases (11.87%), and the association of multiple types of pain such as the combination of site-specific pain with pain related to non-resumption of transit in 24 cases (7.1%), the combination of shoulder pain with pain related to non-resumption of transit in 23 cases (6.6%), and finally the combination of site-specific pain with CO2-related shoulder pain (10 cases = 03%).

The reduction in the intensity of postoperative pain is one of the greatest advantages of laparoscopy compared to open surgery [4]. In our series, no pain was recorded in 54 patients (16.02%) on POD1.

Spastic pains induced by postoperative ileus are less during laparoscopic surgery, with a rapid resumption of transit [9,10].

Pain resulting from direct tissue injury (skin incision points for trocars, site of the operated organ) is easily controlled by conventional medical treatments (paracetamol and nonsteroidal anti-inflammatory drugs [9]). For some authors, the use of local anesthetics at the skin incision sites of the trocars, direct infiltration of the site of the operated organ, or a block of the rectus sheath bilaterally above the umbilicus with approximately 15 ml of 0.25% bupivacaine on each side, would better control the intensity of post-laparoscopy pain [10].

Shoulder pain specific to laparoscopic approach is still poorly understood [4,11]. To explain its origin, several factors have been suggested, such as: distension of the peritoneal cavity by insufflated CO2 and tensioning of nerves and cutaneous vessels, with release of inflammation mediators and neuropraxia of the phrenic nerve related to the acidotic effect of CO2. [1,4,9,12,13].

5. Conclusion

Our study has demonstrated that postoperative pain following laparoscopic surgery is multifactorial. Three main etiologies were identified, namely pain at the surgical site, pain related to non-resumption of intestinal transit, and shoulder pain. However, this pain is often of low intensity, easily manageable, and even absent in some patients on POD1, and it is easily alleviated by first-line analgesics. Moreover, it often does not persist over time. Thus, our findings add to the existing literature demonstrating that laparoscopy is associated with less postoperative pain.

Compliance with ethical standards

Disclosure of conflict of interest

The author declare that they have no conflicts of interest.

Statement of ethical approval

The data and files of patiénts presented in this manuscript are available at the Department of General Surgery of the University Hospital of Ain Taya.

Statement of informed consent

All patients consent to their inclusion in this work and the publication of the results.

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Availability of Data and Materials

The data (Patient records, information sheets for each patient) are available and entered in Excel and Word formats

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