

Original article

The use of drains and delayed closure of the operative wound in children with complicated appendicitis

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Abstract

Introduction. There is evidence that not using intracavitary drains in the management of acute appendicitis, as well as performing primary closure of the operative wound in these cases, does not lead to an increase in post-surgical complications. **Objective.** To describe the development of complications and hospital indicators in two groups of patients with acute appendicitis, one group with drains and secondary closure of the operative wound, and another group without drains and with primary closure. **Methodology.** Descriptive cross-sectional study. 498 files of children diagnosed with acute appendicitis were reviewed. Of these, 156 were included in the study. Two analysis groups were formed. The first described the use of abdominal drains and the second related to the closure of the surgical wound. Morbidity and hospital indicators were compared. **Results.** Significant differences were found in the need for reoperation (-7.3) and in the value of some hospital indicators: use of antibiotics (-0.48), use of parenteral analgesics (-0.49), initiation of oral feeding (-0.35), and hospital stay (-0.59); which were lower in the primary closure group. However, no significant differences were found in the use of postoperative drains. **Conclusion.** Secondary closure of the surgical wound favors reoperation and increases hospital indicators.

Keywords

Appendicitis, Appendectomy, Drainage, Postoperative Complications, Pediatrics.

Resumen

Introducción. Existe evidencia que el no utilizar drenos intracavitarios en el manejo de la apendicitis aguda, así como realizar el cierre primario de la herida operatoria en estos casos, no implica un aumento en las complicaciones postquirúrgicas. **Objetivo.** Describir el desarrollo de complicaciones e indicadores hospitalarios en dos grupos de pacientes con apendicitis aguda, un grupo con drenos y cierre secundario de la herida operatoria, y otro grupo sin drenos y con cierre primario. **Metodología.** Estudio transversal descriptivo. Se revisaron 498 expedientes de niños con diagnóstico de apendicitis aguda. De estos se incluyeron 156 en el estudio. Se formaron dos grupos de análisis. El primero describiendo el uso de drenos abdominales y el segundo relacionado con el cierre de la herida operatoria. Se comparó la morbilidad y los indicadores hospitalarios. **Resultados.** Se encontraron diferencias significativas en la necesidad de reintervención (-7,3) y en el valor de algunos indicadores hospitalarios: uso de antibióticos (-0,48), uso de analgésicos parenterales (-0,49), inicio de la vía oral (-0,35) y estancia hospitalaria (-0,59); que fueron menores en el grupo del cierre primario. Sin embargo, en el uso de drenos postoperatorios no se encontraron diferencias significativas. **Conclusión.** El cierre secundario de la herida operatoria favorece la reintervención y aumenta los indicadores hospitalarios.

Palabras clave

Apendicitis, Apendicectomía, Drenaje, Complicaciones Posoperatorias, Pediatría.



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Uso de drenos y cierre secundario de herida operatoria en niños y niñas con apendicitis aguda complicada

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No conflicts of interest.

Introduction

Traditionally, the management of acute appendicitis complicated by peritonitis has been exploratory laparotomy plus appen-

dectomy, placement of intraperitoneal drainage, and secondary closure of the surgical wound, in addition to other measures associated with the management of this disease, such as non-surgical management.ⁱ

Since the late 20th century, there has been debate about the usefulness of intra-abdominal drains and the management of the surgical wound in cases of acute appendicitis in the pediatric age.ⁱⁱ There is even evidence suggesting that the surgical wound should be closed with continuous sutures in cases of complicated appendicitis.ⁱⁱⁱ Although they can reduce the incidence of post surgical complications of an infectious nature, it has also been shown that their use does not provide benefits but, on the contrary, is associated with negative post outcomes.^{iv}

There are several references to this change in practice in the literature. In a 2007 case-control study, Narci *et al.*, compared both approaches and concluded that it was advisable to discontinue the use of intraperitoneal drainage in this type of patient.^v

It is internationally accepted that the perforation rate varies from 16 % to 40 %, with a higher frequency in younger age groups (40-57 %) and in patients over 50 years of age (55-70 %). Appendicular perforation is associated with increased morbidity and mortality compared to clinical conditions where no perforation is evident. The risk of mortality from acute non-gangrenous appendicitis is less than 0.1 %, but this risk rises to 0.6 % in gangrenous appendicitis and increases to around 5 % when associated with perforation.ⁱⁱⁱ

The main objective of this research is to describe the complications of perforated acute appendicitis with peritonitis in pediatric patients at the San Rafael National Hospital between January 1, 2021, and August 31, 2022.

Methodology

This was an observational, cross-sectional, descriptive study in which all the files of patients discharged from the pediatrics department of a second-level healthcare hospital with a diagnosis of perforated appendicitis with peritonitis, between January 1, 2021, and August 31, 2022, were reviewed. The population consisted of 498 records of all acute appendicitis cases, both perforated and non-perforated. The inclusion criteria were a diagnosis of acute gangrenous or perforated appendicitis with peritonitis, intra-abdominal abscesses, or appendicular abscesses during the operative and postoperative periods, and discharge from the pediatric ward. Exclusion criteria were: diagnosis of acute edematous, suppurative, or fibrinopurulent appendicitis; patients with incomplete medical records; and laparoscopic procedures. A total of 156 patients were reviewed, corresponding to all those who met the above criteria.

Due to the variability of surgical management, it was decided to perform two separate analyses. One analysis focused on the use of drains and was divided into two groups: with drains (123 patients) and without drains (33 patients). The other group referred to the method of surgical wound closure and was similarly divided into two subgroups. One group consisted of patients with primary closure, i.e., the operative wound was closed during the same surgical procedure (88 patients). The other group consisted of patients with secondary, also called delayed closure (68 cases); in these patients, the skin was not closed at the end of the surgical procedure, and closure was performed upon discharge.

General demographic variables were investigated: age, sex, and place of origin. The variables for the development of complications were: surgical site infection, presence of abdominal abscesses, intestinal obstruction syndrome, and surgical reoperations. The following hospital indicators were also described: operative time, days of intravenous antibiotic use, days of intravenous analgesia use, days of fasting, and length of hospital stay.

The data were obtained from hospital records to compile the required information. The information was downloaded into an Office 365 Excel spreadsheet designed for this purpose. Frequencies, percentages, and means were used for descriptive statistical analysis. In addition, the difference in means for hospital variables and indices, as well as the difference in proportions of complications, were calculated in the same program.

Results

Of the 156 cases investigated, 59.6 % were male, and the average age was 8.5 years, ranging from 2.2 to 11.9 years. The most frequent age group was between nine and 12 years, with a total of 74 cases (Figure 1). Most of the patients were from the department of La Libertad (42.3 %), followed by Chalatenango (16.7 %), Ahuachapán and Santa Ana (13.5 % each), Sonsonate (11.5 %), and others (2.3 %). Of the 156 cases, 84 % were in the perforated phase with peritonitis and/or localized intra-abdominal abscesses, and 16 % were in the gangrenous phase.

Use of intra-abdominal drains

Intra-abdominal drains were used in 123 patients, while 33 patients did not receive drains. Of the group that received drains, as shown in Figure 2, 23.5 % developed some complication. The most frequent

complication was surgical site infection at 9.8 %, followed by surgical reoperation at 8.1 %, obstructive syndromes at 3.2 %, and the formation of intra-abdominal abscesses at 2.4 %. The total number of reoperations included two laparoscopies to resolve omentum evisceration through the drain hole and two incisional hernia repairs, which appeared in the late postoperative period.

Fifteen percent of patients managed without intracavitary drains experienced complications. In addition, the following percentages were reported for other complications: 6 % for surgical site infection, 3 % for reoperation, and 3 % for obstructive syndrome and abdominal abscess formation (Figure 2).

When testing the difference in proportions with a 95 % CI and $p < 0.05$, no significant differences were found in the development of complications during the postoperative period between the two groups.

The averages of the in-hospital indicators were measured, revealing that the operative time was 54.5 minutes for patients with drains, compared to 61.2 minutes for those without drains (Table 1). In patients with drains, the average use of IV antibiotics was 3.67 days, while in patients without drains, the average was 3.15 days. Intravenous analgesia use was 2.39 days with drains compared to 1.89 days without drains. Oral administration began 1.56 days after the patients with drains, compared to 1.15 days in the group without drains. The hospital stay was 4.33 days for the group with drains and 3.48 days for the group without drains. All indicator averages are lower in the group that did not have drains placed, except for operative time (Table 1).

When running the mean difference test with a 95 % CI and $p < 0.05$ for each of the hospital indicators, no statistically significant differences were found in both groups.

Management of the operative wound

Sixty-eight patients underwent primary closure of the operative wound, while 88 patients underwent secondary closure of the wound. There were a total of 11 complications in patients with primary wound closure, representing 16.2 % of cases. According to the type of complications, 8.8 % were due to surgical site infection, 2.9 % to abdominal abscesses, 1.5 % to intestinal obstructions, and 2.9 % to reoperations. Regarding secondary closure, there were a total of 23 complications, representing 26.1 % of cases. Of these, the specific percentages for each of the postoperative complications were surgical site infection 9 %, abdominal abscesses 2.3 %, intestinal obstructions 4.5 %, and reoperations 10.2 % (Figure 3).

It can be observed that the overall complication rate is lower in patients who underwent primary closure of the operative wound, and the specific rates for each complication are also lower, except for abdominal abscess formation.

When performing the difference of proportions test with a 95 % CI and $p < 0.05$, no significant differences were found in the development of complications, except for the reoperation variable. There is a greater percentage difference in patients with secondary closure (7.3 %), which is statistically significant.

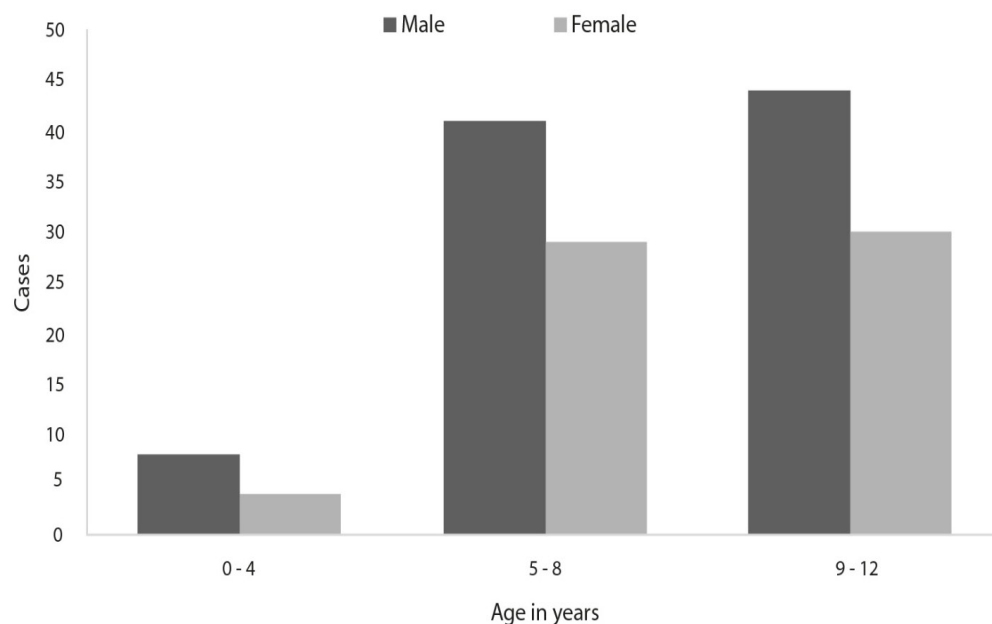


Figure 1. Patients by gender and age group.

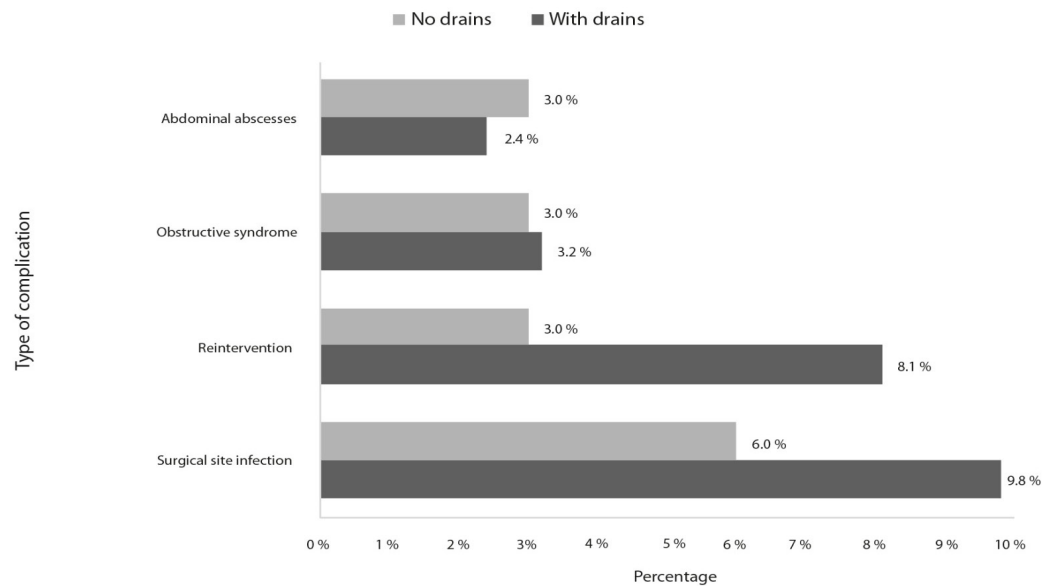


Figure 2. Development of postoperative complications

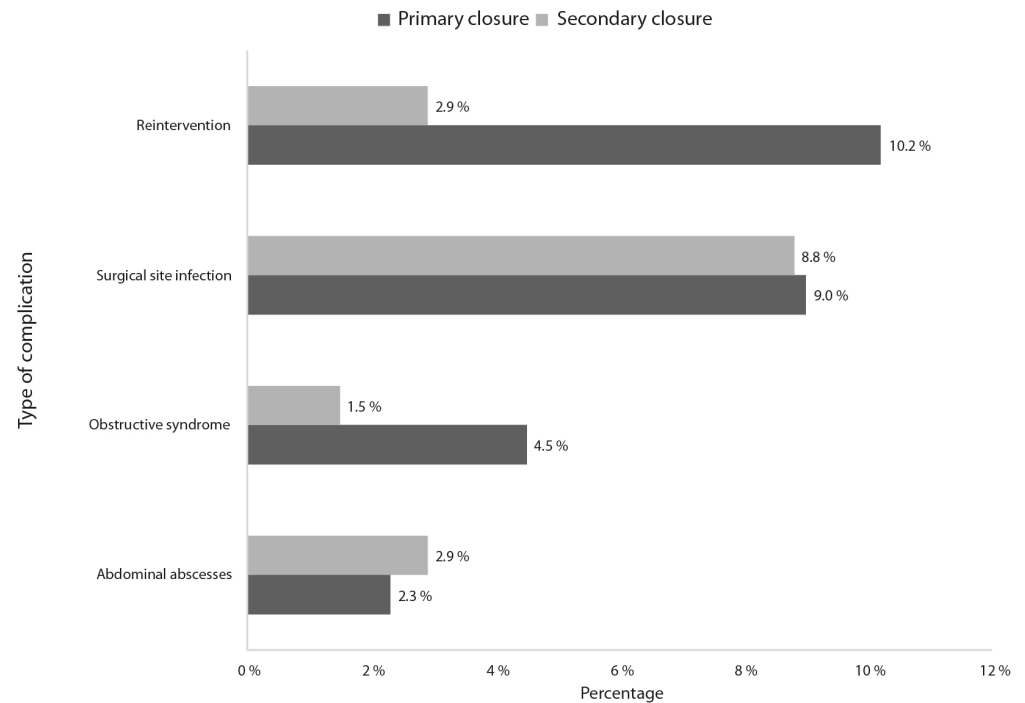


Figura 3. Types of complications according to wound closure technique.

Table 1. Average of hospital indicators of patients, according to the type of intervention during the surgical procedure.

Type of Intervention	Operative Time (Minutes)	Antibiotics (Days)	IR Analgesia (Days)	Start of OR (Days)	Hospital Stay (Days)
With drains	54.5 (± 20.79)	3.67 (± 1.45)	2.39 (± 1.08)	1.56 (± 1.02)	4.33 (± 1.49)
Without drains	61.15 (± 17.50)	3.15 (± 1.25)	1.85 (± 0.66)	1.15 (± 0.44)	3.48 (± 1.32)
Secondary closures	53.1(± 17.16)	3.72 (± 1.43)	2.49 (± 1.17)	1.63 (± 1.14)	4.41(± 1.45)
Primary closure	59.5(± 23.34)	3.29 (± 1.38)	2 (± 0.73)	1.28 (± 0.54)	3.82 (± 1.49)

IV: Intravenous route. PO: Oral route.

The average hospital indicators were 59.5 minutes for primary closure and 53.1 minutes for secondary closure, and the use of antibiotics was 3.29 days for primary closure and 3.7 days for secondary closure (Table 1). Intra-venous analgesia was two days for primary closure versus 2.49 days for secondary closure; the start of oral administration was 1.28 days for primary closure and 1.63 days for secondary closure. The hospital stay was 3.82 days for primary closure and 4.41 days for secondary closure.

When running the mean difference test with 95 % CI and $p < 0.05$, significant differences were identified in the hospital indicators: use of antibiotics (-0.48), use of parenteral analgesics (-0.49), initiation of oral medication (-0.35), and hospital stay (-0.59), which were lower in the primary closure group. However, no significant difference was found in operating time according to the type of operative wound closure.

Discussion

The analysis found that the epidemiological findings regarding sex, age, and macroscopic findings are consistent with those reported in other studies. It has been reported that this clinical picture is slightly more frequent in male patients of school age.ⁱⁱ Regarding the macroscopic condition in which the cecal appendix was found, it is evident that in most cases, it was in the perforated phase with peritonitis, which corresponds to phase V of the international classification of the World Association of Emergency Surgeons.^{vi}

In July 2015, the third conference of the World Society for Emergency Surgery was held in Jerusalem, at which a consensus was reached on the main controversies regarding the diagnosis and management of acute appendicitis, including the use of drains and the management of the operative wound.^{vii} The recommendations in this document indicate that using intra-abdominal drains and secondary closure of the surgical wound does not reduce the occurrence of complications such as surgical wound infection, abdominal abscess formation, and reoperations following complicated acute appendicitis. On the contrary, it increases the hospital stay for these patients. Therefore, it recommends abandoning these practices in children.^{viii,ix} The percentage of complications obtained in this study is consistent with a study conducted in Finland, which reports that they range from 16 % to 40 %.

In 2012, Akkoyun *et al.*, in a retrospective review of 234 cases of perforated appendicitis between 1998 and 2011, concluded that placing intra-abdominal drains prolongs the

operating time.^x Similarly, in 2015, Song *et al.* concluded that patients without drains have a shorter hospital stay and a lower incidence of postoperative abscesses compared to those who had drains placed.^{xi}

In a meta-analysis conducted in China and published in 2022, which included, without drains), concluded that the use of drains does not affect the development of intra-abdominal collections in acute appendicitis. However, it does significantly increase the risk of complications such as the development of fistulas, surgical site infections, intestinal obstruction, paralytic ileus, and prolonged hospital stay.^{xiii}

A reduction in pain at the wound site was also demonstrated in cases where drains were not used, compared to those where they were;^{xiv} however, the study found statistically significant differences between the two groups.

On the other hand, when considering surgical wound closure, the findings of this study are consistent with the consensus of the 2020 Jerusalem guidelines;^{viii} in its recommendation 4.15, which indicates that secondary closure of the surgical wound in perforated appendectomies prolongs hospital stay, increases hospitalization costs without reducing the risk of surgical site infection. A 2011 study conducted in China took 70 patients. It divided them into two groups of 35 people each, with each group corresponding to a operative wound management strategy. The study concluded that patients with primary closure had a higher rate of operative wound infection compared to those with secondary closure. Therefore, it is recommended that secondary closure of the operative wound be used as a management strategy.^{xv} In contrast, a multicenter, randomized controlled study conducted in Thailand in 2018 found that the infection rate in the primary closure group was slightly lower than in the secondary closure group. Additionally, hospital costs in the first group were lower.^{xvi} A 2023 follow-up by the same group of researchers confirms their results and strongly recommends primary closure of the operative wound.^{xvii}

Regarding hospital indicators for the use of drains, there is no significant difference when comparing operative time, days of antibiotic use, days of analgesic use, initiation of oral administration, and hospital stay between the two groups, except for operative time, which was shorter in the group where drains were used, with a difference that was not statistically significant. Unlike the reviewed literature, which shows a decrease in these indicators in the group where drains

were used,^{vii} the Jerusalem guideline in its recommendation 4.13 suggests that the use of drains increases hospital stay, antibiotic use, and intravenous analgesics, and also prolongs operative time and the initiation of feeding. In 2021, a review of 1 762 patients under the age of 15 who underwent appendectomy found that patients who used drains had a longer hospital stay than patients who did not use them.^{xviii} Similarly, a study conducted in 2018 found a longer hospital stay in the group in which drains were used.^{iv} The data found in the study group are consistent with the recommendations of the Jerusalem guidelines of the World Society for Emergency Surgery,^{vii} which state that delayed closure increases hospital stays and hospital costs and does not reduce the incidence of ISO.^{viii,xii,xiii}

One limitation of this study is its retrospective nature, which may mean other variables influenced the frequency of complications, such as the condition of the patients. In addition, the study groups were not mutually exclusive, which could have allowed them to influence each other. However, no published articles on this topic have been found in El Salvador, making this the first study conducted in the pediatric age group.

Conclusion

The use of intracavitary drains did not reduce the occurrence of postoperative complications, nor did it affect the hospital indicators observed in the patients evaluated. However, in the closure of the operative wound, the percentage of reoperations in cases of secondary closure was the only complication with statistical significance. However, the averages for antibiotic and analgesic use, initiation of oral feeding, and hospital stay were lower in the group that underwent primary closure in this study.

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