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Original Article

SIMPLE LIGATION OR LIGATION AND PURSE STRING INVAGINATION FOR THE TREATMENT OF THE APPENDICEAL STUMP: A PROSPECTIVE, RANDOMIZED TRIAL

Ligadura simples ou ligadura com confecção de bolsa e sepultamento para tratamento do coto apendicular: estudo comparativo prospectivo randomizado

Lauro José Victor Avellán **NEVES**, Alberto Julius Alves **WAINSTEIN**, Wallace Ceoto **MATHIAS**, Fabrizio Parreira Dias **COSTA**, Judson Henrique de **CASTRO**, Paulo Roberto **SAVASSI-ROCHA**

From Hospital Júlia Kubitschek, Belo Horizonte, MG, Brazil.

ABSTRACT – ***Background*** - Although acute appendicitis is one of the most common surgical diseases, the best treatment of the appendicular stump has not been defined. At laparotomy for appendectomy the stump is treated preferably by ligation and burial of the stump and, in laparoscopic surgery, by simple ligation or clamping. ***Aim*** - To compare two techniques for the treatment of appendicular stump in appendectomy (simple ligation vs ligation with purse making and burial) by a prospective and randomized study. ***Methods*** - Between the years 2003 and 2005, 113 patients underwent laparotomy appendectomy for acute appendicitis. The appendiceal stump was treated by simple ligation in 49 cases and by ligation and burial in 64 cases. The two groups were similar in terms of average age, gender, preoperative signs and symptoms, time of disease progression and stage of appendicitis diagnosed histopathological examination. ***Results*** - There was no statistically significant difference between the two groups regarding the duration of operation, complications (wound infection, wound dehiscence, abscess formation, intestinal obstruction, fistula and seroma) or hospital stay. ***Conclusions*** - Both techniques are equally safe for treatment of appendicular stump, and so, it is possible to recommend simple ligation because it is easier to be done.

HEADINGS – Appendectomy. Appendicitis. Surgical procedures, operative. Randomized controlled trial.

Correspondence:
Lauro José Victor Avellán Neves,
e mail lauroavellan@gmail.com

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RESUMO – ***Racional*** - Apesar da apendicite aguda ser uma das afecções cirúrgicas mais comuns, o melhor tratamento do coto apendicular ainda não foi definido. Na apendicectomia laparotômica há preferência pela ligadura e sepultamento do coto enquanto, na laparoscópica, pela ligadura simples ou clampeamento. ***Objetivo*** - Comparar duas técnicas de tratamento do coto apendicular na apendicectomia laparotômica (ligadura simples vs ligadura com confecção de bolsa e sepultamento) por meio de análise prospectiva e randomizada. ***Métodos*** - Entre os anos de 2003 e 2005, 113 pacientes foram submetidos à apendicectomia laparotômica por apendicite aguda. O coto apendicular foi tratado por ligadura simples em 49 casos e por ligadura e sepultamento em 64 casos. Os dois grupos foram semelhantes em relação às médias de idade, gênero, sinais e sintomas pré-operatórios, tempo de evolução da doença e fase da apendicite aguda diagnosticada pelo exame anatomopatológico. ***Resultados*** - Não houve diferença estatística significativa entre os dois grupos em relação ao tempo de duração da operação, presença de complicações (infecção de ferida operatória, deiscência de ferida, formação de abscessos, obstrução intestinal, seroma e formação de fístula) ou tempo de internação. ***Conclusão*** - As duas técnicas são igualmente seguras para tratamento do coto apendicular.

DESCRITORES - Apendicectomia. Apendicite. Procedimentos cirúrgicos operatórios. Ensaio clínico controlado aleatório.

INTRODUCTION

Acute appendicitis is the most common abdominal emergency surgical disease. Is suggested that between 6.7% and 8.6% of the people of the Western world submit appendicitis at some point in their lives[1,8]. Although thousands of appendectomies are performed annually worldwide, the treatment of appendicular stump has not been uniform.

Since the first descriptions of the appendectomies appendicular stump was treated differently. A simple ligation was the preferred method of treatment in the first operations until questions arise about its effectiveness[10].Some authors stressed the risks of infection and loosening of the ligature, suggesting that the stump should be covered or buried by suture[10].

In the first half of the twentieth century, ligation and burial of the stump, with suture in tobacco pouch, gained popularity and is supported by Babcock[4] and Ochsner[17] renowned surgeons at the time. Both believed that the making of the pouch was superior for three reasons: on the stump was the source of contamination in the peritoneal cavity, closure of the intestinal wall was inadequate with simple ligation and there would be greater risk of adhesion formation around the appendiceal stump if it is not buried .

The first studies comparing the techniques of simple ligation and ligation and burial were retrospective and showed superiority of simple ligation[11,21,22]. The randomized and controlled prospective studies on the subject show equivalence between the two techniques[3,12,13,23] or superiority of simple ligation with shorter duration of operation[13] or lower incidence of wound infection[9].

Currently, the appendicular stump is still treated preferentially by two techniques: simple ligation and ligation with burying the appendicular stump[19]. In Hospital Júlia Kubitschek, with the introduction of laparoscopic surgery for treatment of acute appendicitis appendicular stump, it was treated in two different ways. Appendectomies performed in the laparotomy and ligation of the stump and burial, while in laparoscopic is performed only simple ligation.

This fact motivated this research with the aim of comparing the two techniques for treatment of appendicular stump (simple ligation vs ligation with making tobacco pouch for burial) through analysis of prospective and randomized study compared the morbidity, mortality, duration of operation, length of stay.

METHOD

Between 2003 and 2005 were 120 patients operated for acute appendicitis. Patients were divided into two groups according to the day of operation. In even days appendectomies were performed by the burial and ligation (ligation of the stump, making tobacco pouch and burial of the stump), while in odd it was used single isolated ligation of the stump. Patient selection followed the inclusion criteria: aged between 13 and 60 years who underwent appendectomy for acute appendicitis; patient acceptance and signing the informed consent; operative and pathological confirmation of the diagnosis of acute appendicitis. The exclusion criteria were:pregnant women; immunosuppressed patients or patients with autoimmune diseases; patients using corticosteroids; patients with severe disease complicated by anesthesia; use of diagnostic laparoscopy.

It was conducted a pilot study with 20 individuals, 10 undergoing on each surgical technique, in order to calculate the sample size. According to Callegari-Jacques[6], if n (population size) is unknown, it can be used the formula:

$$n = \frac{Z^2_{\alpha/2} \cdot p^{(1-p)}}{d^2} \quad (1)$$

here: p=proportion of complications for each surgical technique, the main study variable; Zα / 2=confidence interval; d=precision, in this study 5%.

The sample size calculation indicated the minimum number of 42 subjects in each surgical technique which total 84 individuals for the final sample (n).

Statistical analysis used the Epi Info (TM) 3.5.1 and the level of significance was $p<0.05$. To compare quantitative variables between the two surgical techniques, it was used the independent T-test comparison of means. To evaluate the qualitative variables it was used the chi-square test.

The groups were similar in terms of average age, gender, clinical manifestations (Table 1), time to disease progression (Table 2) and stage of appendicitis by pathology

TABLE 1 – Distribution of patients according to clinical manifestations between the groups

Clinical Manifestation	Groups		p value*
	Simple ligation (n)	Ligation and burial (n)	
Vomiting	39	35	0,319
Hyporexia	47	37	0,803
Fever	18	25	0,113
Pain in right iliac fossa	51	40	0,796
Blumberg sign	54	43	0,610

n = number of patients
* Chi-square test for proportions Pearson

TABLE 2 – Distribution of patients according to time elapsed between the groups

Time evolution (Hours	Groups		p value*
	Simple ligation (n)	Ligation and burial (n)	
1-12	3	5	0,480
12-24	18	21	0,631
24-48	16	21	0,411
More than 48	12	17	0,353
Total	**49**	**64**	

n = number of patients
* Chi-square test for proportions Pearson

RESULTS

Of the 120 patients who underwent surgery, seven were excluded (Table 3). Thus, it was obtained for analysis 49 patients in the simple ligation and 64 in the ligation group and burial.

TABLE 3 – Reasons for patient exclusion

REASON FOR EXCLUSION	GRUPOS	
	Ligation and burial (n)	Simple ligation (n)
Necrotic base of the appendix wall reaching the cecum treated by segmental right ileocolectomy	2	1
Hole at the base of the cecum and abscess, without identification of the appendix treated by suture and drainage hole	1	0
Bleeding from the base of the cecum after lysis of adhesions treated by purse-string suture and burial of the stump with the purpose of hemostasis	0	1
Diagnostic pathology of carcinoid tumor of the appendix	0	1
Patient with acute on chronic atrial fibrillation during anesthesia	0	1

n = number of patients

The groups were similar in the stage of appendicitis, diagnosed by pathological examination (Table 4).

TABLE 4 - Distribution of patients regarding the stage of appendicitis by pathology and groups

Phase appendicitis	Grupos		
	Simple ligation	Ligation and burial(n)	p value *
Edematous	9	15	0,221
Fibrino-purulent	29	30	0,896
Necrotic	3	7	0,206
Perforated	8	12	0,371
Total	**49**	**64**	

n = number of patients
* Chi-square test for proportions Pearson

The duration of the operation (Table 5) was, on average, 69.8 minutes in simple ligation group and 75.3 minutes in the ligation group and burial. There was no statistical difference between the length of hospitalization between the two groups (p=0.325).

Regarding the postoperative period 15.1% of patients had complications. There were no deaths. The most common complication was wound infection present in 9.7% of cases. Other complications were abscess, fistula entero-cutaneous, postoperative ileus, and septic shock with seroma incidence 0.9% each. There was no statistically significant difference in complications between the two groups.

TABLE 5 – Time taken for the procedures

Grupos	Duration			
	Minimum (minutes)	Maximum (minutes)	Mean (minutes)	MD (minutes)
Simple ligation	20,0	150,0	69,8	29,8
Ligation and burial	35,0	155,0	75,3	29,2

The duration of postoperative hospitalization was on average 1.9 days in the ligation group and 2.4 days in simple ligation group and burial. There was no statistical difference in relation to length of hospitalization between the two groups (p=0.814).

DISCUSSION

Of the 120 patients who underwent surgery, seven were excluded. Appendectomy performed by another diagnosis occurs in about 10.0% of cases of laparotomy for suspected appendicitis[18]. Only one patient was operated with a diagnosis of cancer, representing less than 1% of cases. The involvement of the cecum by inflammation of appendicitis occurred in 2.8% of cases and was the main cause of exclusion of patients. Three cases showed friability and necrosis of the cecum and were treated with ileocolectomy target with good outcome. It appears, in literature, the involvement of the cecum is a common condition and can occur in up to 4.8% of cases of acute appendicitis[7].

The sample of 113 patients, exceeded the minimum of 84 patients, given the sample size calculation and is the largest series of similar studies in Brazil[2,3,12]. This occurred not only by the availability of cases, but also by the low percentage of exclusion of patients and no patient loss due to lack of monitoring.

The groups obtained were homogeneous in relation to features in the preoperative period and in relation to the result of pathological examination of the appendix enables the comparison between the two techniques.

The operative time was on average 5.5 minutes greater in cases in which it was ligated and the manufacturing of the bag compared to simple ligation. This difference, however, was not significant taking into account the average time of operations, which were, respectively, from 69.8 minutes for the simple ligation group and 75.3 minutes for the ligation group and burial. All operations of this study were done by residents, which justifies the longer operative time. In a similar study, but without details on the surgical team, the operative time was significantly greater in the technique of ligation and burial of the stump, with a median of 40 minutes for simple ligation and ligation

for 45 minutes and burial[7]. Lavonius, et al.[13]also found more time for the ligation group and burial, however, this group, the operations were performed by less experienced surgeons and was performed suturing the peritoneum, a procedure not performed in the group of simple ligation.

By adding an appendectomy in surgical time (making the pouch of tobacco for the burial of the stump) the time spent on this procedure will increase, necessarily, the surgical end time. In this study, the difference of 5.5 minutes between the two techniques was not significant from a statistical viewpoint, probably because the operative time was longer than usual. The mean time observed in this study was superior to that in 11 series in which surgeons, possibly more experienced, were responsible for operations. Accordingly, the average time ranged between 20 (± 12.6) minutes to 66.9 (± 21.6)[19]minutes. Possibly in a study where the operative time was shorter, this variable might be significant, as suggested in a retrospective study[21] and confirmed in a prospective study7. Besides the time spent for making the pouch of tobacco and burial of the stump, there is need for using additional suture.

There were no deaths in the study. Mortality after appendectomy is low and the value found was similar to that reported in the literature[2,12]. The most common complication was wound infection present in 9.7% of cases. The infection rate in similar studies ranged between 3.0% and 18.4%[13,23]. High rate[23] is justified by the fact that it was not used prophylactic antibiotics. Lower rate of infection found, 3.0%, did not specified the time evolution of the signs and symptoms or the stage of acute appendicitis[13], factors that alter the incidence of complications[5,18]. The infection rates found in other studies involving patients at all stages of acute appendicitis were similar to those observed in this study[2,3,7,12].

The appendiceal stump is considered contaminated and structure, according to defenders of the burial of the stump, his presence in the abdominal cavity increases the risk of infection[17]. However, the first retrospective studies comparing the techniques demonstrated a lower incidence of infection when only a simple ligation was performed[11,21]. This finding was not repeated in prospective studies where the incidence of wound infection was similar in both groups[3,7,12,13,22,23]. We believe this change occurred by advancing the inclusion of antimicrobial therapy and prophylaxis of infection preoperatively. In this study no significant difference in the incidence of wound infection between the two groups, supporting other recent research[3,12,13,22,23].

Intracavitary abscesses are uncommon complications of appendectomies[21].The presence of intra-abdominal abscess, for the advocates of burial, would be greater in cases where the infected stump invagination remained without abdominal cavity[17]. In contrast, proponents argue that simple ligation of the stump in the peritoneal cavity, would be in contact with the defense mechanisms of the peritoneum, which would be capable of preventing the formation of intraperitoneal abscesses. According to this theory, the abscesses arise with higher incidence in cases where the stump was buried in the wall of the cecum and remained isolated from the peritoneal defense[21]. We found only one case of intra-abdominal abscess in the ligation group and burial, the result was not statistically significant (p=0.379). The current literature shows that there is no difference in the incidence of intracavitary abscesses after simple ligation or ligation and burial of the stump[3,12,13].

The enterocutaneous fistula as a complication of appendectomy, may occur due to inadequate closure of the intestinal wall. Although uncommon, is a feared complication because the treatment can be difficult[15]. Concern that the closure of the appendiceal stump would be inappropriate to simple ligation was the main argument of defenders of the burial or inversion of the stump[10,17]. Theoretically, ligation followed by burial through the pouch of tobacco, would double security to the closing of the intestinal wall, decreasing the risk of fistula formation[21]. The evidence indicates, however, no difference in the incidence of fistulas between the techniques of simple ligation and burial of the stump and the appendiceal stump closure is suitable for simple ligation[3,12,21]. In our study we found a case of fistula, and burial in the ligation group, which theoretically would be safer. However, this finding was not statistically significant (p=0.479), corroborating the literature.

The formation of adhesions leading to postoperative ileus and intestinal obstruction are rare complications, whose manifestations may occur from the earliest days up to several years after appendectomy[7]. Theoretically, the appendicular stump in the abdominal cavity was connected place conducive to adhesion formation[17,21]. This theory was not proven. Retrospective studies of patients with a follow up to five years, showed just the opposite. Patients who underwent ligation and burial have a higher incidence of adhesions and intestinal obstructions in comparison to those who underwent simple ligation[11,22]. In prospective studies, follow-up time of patients was no more than a year, limiting the diagnosis of adhesions. Still, the occurrence of adhesions and intestinal obstruction was also greater in the ligation and burial in the study by Engstrom & Fenyo[7]. In this study, no significant difference in the incidence of postoperative ileus between the two groups, corroborating other prospective studies[3,12,13].

In addition to the reported complications, there was a case of septic shock and one case of seroma and burial groups ligation and simple ligation, respectively. These complications did not differ significantly between the two groups after appendectomies are uncommon and were not mentioned in the literature comparing the two techniques now available.

The length of stay after appendectomy was on

average 1.9 days in group simple ligation group and 2.4 days in the ligation and burial. There was no statistically significant difference between the two groups regarding length of stay. In comparative literature, now available, the time of hospitalization was higher in patients undergoing manufacture of the bag in relation to simple ligation in only one study[20]. In other studies, which included this variable, the results were similar to those obtained in this study[3,7,12,13,22,23].

The making of the tobacco pouch for burial of the stump causes changes in the anatomy of the cecum.These changes may be confused with cancer on imaging examination inducing the patient to be subjected unnecessarily to the stress of diagnostic uncertainty and/or invasive tests or operations[14,16]. To avoid this, some authors recommend a simple ligation technique for treatment of appendicular stump[7,14,16].

In several diseases of surgical treatment are so-called standard surgical techniques, the best-performing[21]. The present study showed that the techniques of simple ligation and ligation with burial are equivalent in relation to duration of operation, complications and hospitalization time. However, the manufacture of tobacco pouch, is an additional surgical procedure that can change the anatomy of the cecum, with future risk of iatrogenic injury. The technique is simple ligation of implementation easier and causes fewer changes in the anatomy of the cecum, which is why it could be considered the preferred technique for treatment of appendicular stump.

CONCLUSIONS

Both techniques are equally safe for treatment of appendicular stump, and so, it is possible to recommend simple ligation because it is easier to be done.

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