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Transumbilical Laparoscopic Assisted Appendectomy Compared with Transumbilical Laparoscopic Appendectomy in Acute Appendicitis-Analysis of 1000 Cases

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Abstract

Background: Acute appendicitis (AA) is the most common cause of acute abdominal surgery. The available scientific evidence does not show consensus of opinion about the best access route for the treatment of AA.

Aim: To compare the techniques Laparoscopic Appendectomy (LA) and Transumbilical Laparoscpoic Assisted Appendectomy (TULAA).

Methods: This is a retrospective study comparing two series with 1000 patients. Variables were: operative time, hospital stay, postoperative complications, postoperative pain, earlier return to daily activities, conversion in relation to the type of operation and motive of the conversion.

Results: The averaged surgical time was 75.5 minutes in LA and 51.7 minutes in TULAA. The incidence of postoperative pain showed no statistically significant difference. General complications had incidence of 9.6% in LA and 7.6% in TULAA. Regarding to wound infection the incidence was 2.7% and 2.4% to LA group and TULAA group respectively. The earlier return to daily activities and short hospital stay were observed in both groups. When conversion was necessary in TULAA group, the techniques were laparotomic appendectomy (59.4%), LA (17.4%) and TULAA with a second incision (23.2%). The patients submitted to LA who needed conversion were treated by laparotomic technique.

Conclusion: The effectiveness and safety of trans-umbilical laparoscopic appendectomy can make this technique the preferred choice in the initial management of patients with acute appendicitis.

Keywords: Acute appendicitis; Laparoscopic appendectomy; Trans-umbilical laparoscopic assisted appendectomy; Minimally invasive surgery

Introduction

Acute appendicitis (AA) remains the leading cause of non-traumatic surgical acute abdomen. The commonly recognized advantages of laparoscopic appendectomy (LA) compared to the conventional approach would be: reduction of postoperative pain, shorter hospital stay, faster return to professional activities, lower overall costs and promote better cosmetic results. However, LA demands increased surgical time, operative cost is higher and it is technically more difficult when compared with the conventional technique [1-4].

The trans-umbilical laparoscopic assisted appendectomy (TULAA) rests on the logical argument to combine the simplicity, speed and low cost of removal of the appendix by the conventional technique with the diagnostic efficacy, the more comfortable after surgery and less morbidity of the laparoscopic approach [5-7].

Within the context of uncertainty among which surgical treatment is more effective for AA and based on the widelyconsulted literature, in which there is no reference comparing these two techniques, it is appropriate to conduct this study. With reason, it can be stated that the introduction of TULAA as an option of surgical access in the treatment of acute appendicitis rekindle and can further inflame this discussion.

The objective of this study is to contribute to the discussion, trying to define the best access route for the initial approach of patients diagnosed with AA.

Method

This is a retrospective study comparing two series, performed at the Mother Teresa Hospital in Belo Horizonte - Minas Gerais. The project was approved by the Ethics Committee of the institution. Between January 2000 and February 2010, 1000 patients with suspected or confirmed diagnosis of acute appendicitis underwent appendectomy using the techniques TULLA and LA. The TULAA group was composed of 585 cases and the LA group comprised 415 patients.

The indication of the LA or TULAA was decided based on the availability of equipment, instruments and optic with operatory channel (Figure 1) and experience in video-assisted surgery of the surgeon.

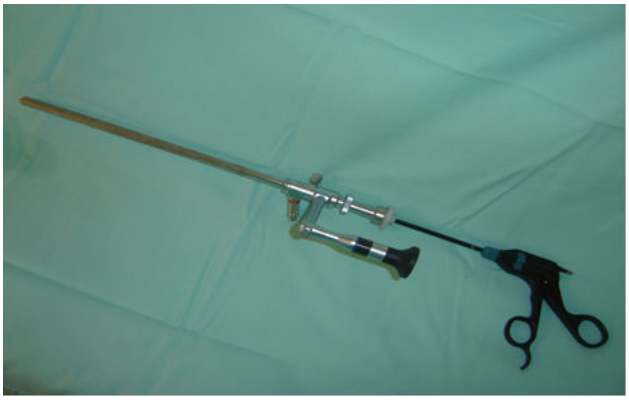

Figure 1: Patients with Body Mass Index (BMI) > 30 kg/m^2 were classified as obese.

In the technique TULAA, pneumoperitoneum was installed after an umbilicus incision of 12 mm. Following optic with operatory channel of 5 mm was introduced by trocar of 11 mm and proceeded to systematic exploration of the abdominal cavity. The patient was positioned supine in the Trendelenburg position and lateralization of 30º to the left. Following the appendix was captured for its distal part with its meso by a 5 mm grasper introduced through the optic with operatory channel. The mobility was assessed while the appendix was pulled until the umbilicus port. The procedure was then the resection of the appendix by conventional way, with progressive ligation of the meso and occlusion of the base of appendix by double ligature using non-absorbable thread polyester 2.0. The cecum was restored to the abdominal cavity and preceded to new insufflation of the abdomen to assess the integrity of the cecum, the appropriate length of the appendicular stump, hemostasis review and aspiration of any residual liquid content within the cavity.

In the laparoscopic technique, two alternatives were used. In the method with the optic with operatory channel, two portals of 11 mm were used in umbilical and suprapubic positions and in classical laparoscopic technique took place an additional 5 mm incision in the left iliac fossa. Skeletonization and the hemostatic control of appendicular meso, including appendicular arteries, was performed by electrocoagulation and sometimes associated with the placement of metal clips. The appendicular base was treated with extracorporeal knot of polyglactin 0, by Roeder's technique, positioned with knot pusher grasper.

Both techniques, LA and TULAA, were performed under general anesthesia with muscle blockers.

The collected data were entered into a database developed in Excel ®. This study considered variables: operative time, postoperative pain, early and late postoperative complications, hospital stay and return to normal activities. Considered as postoperative pain the need for opioid analgesics and/or intravenous analgesia from the second postoperative day and also took into consideration the shoulder pain related to pneumoperitoneum.

The type of operation was compared regarding gender and complications' using contingency tables. The chi-square test with Yates correction was applied to them. Comparisons of the BMI and histopathology were performed using Pearson's chi-square test. The Fisher's Exact test was used when at least one expected frequency is less than 5.

The comparison between age and the surgical technique was performed using the Mann-Whitney test. These assumptions were verified using the Shapiro-Wilk test for normality and Levene test for homogeneity of variances.

The access routes were compared regarding the variables postoperative complications and postoperative pain from contingency tables. In this case, the chi-square test with Yates correction was applied. A comparison between access route and the return to activities (variable with three categories) was held using the Pearson's chi-square test.

Comparisons with hospital stay and operative time were performed using the Mann-Whitney test, since the usual model assumptions (normality and homogeneity of variances) were violated. These assumptions were verified using the Shapiro-Wilk test for normality and the Levene test for homogeneity of variances.

Results

Analysing the data of the studied samples (1000 patients), it is observed that in TULAA the mean age was 29.2 years, while in LA it was 32.2 years.

Both techniques were employed for the treatment of complicated forms (19.7% in LA and 18.4% in TULAA) and uncomplicated forms (74.6% in LA and 77.4% in TULAA) of acute appendicitis.

Regarding the BMI, the LA group has 6.5% of obese and 15.7% of overweight patients. In TULAA group, the obese encompassed 4.7% of patients and 15.6% were classified as overweight.

Females predominated in the both groups, laparoscopic (61%) and laparoscopic assisted approach (68.8%).

Table 1 presents a description of the operative time by surgical technique. It is observed that the patients who were submitted to LA and TULAA presented mean operation time of 75.5 minutes and 51.7 minutes respectively.

Thus, it is observed that patients undergoing to LA had increased operative time, statistically significant compared to the group TULAA.

	Type of Operation						
	LA			TULAA			
	Average	SD	Median	Average	SD	Median	p-value
Operative time	75.5	22.7	70.0	51.7	17.8	50.0	<0.00
SD: Standard deviation; 1: Mann-Whitney test							

Table 1: Comparison between operative time and type of operation.

In the analysis of postoperative pain, there was no statistical significance when TULAA and LA are compared (11.9% and 9.0%, respectively).

The incidence of general postoperative complications was 9.6% in the laparoscopic approach and 7.9% in TULAA group.

Table 2 shows the comparison of complications in relation to specific types of operation. In relation to wound infection, from 415 patients who underwent to LA, 11 (2.7%) developed this complication, and from 585 patients approached by TULAA, 14 (2.4%) had infected wound. The infections (wound infection and Intra-abdominal abscess) are related to complicated forms of acute appendicitis. Some works show that intra-abdominal abscess is related to the direct effects of pneumoperitoneum on peritoneal defense systems. There were not any cases of bleeding. Incisional hernia is related to the opening of apo-neurosis in patients underwent to TULLA. These actions facilitate the exteriorization of cecal appendix.

	Type of operation				
	LA		TULAA		p-value
	n	%	n	%	
Wound infection					
Yes	11	2.7	14	2.4	0.9312
No	404	97.3	571	97.6	
Intra-abdominal abscess					
Yes	8	2.0	5	0.9	0.2232
No	407	98.0	580	99.1	
Incisional hernia					
Yes	0	0.0	2	0.4	0.5153
No	415	100.0	583	99.6	
Intestinal obstruction					
Yes	0	0.0	0	0.0	-
No	415	100.0	585	100.0	
Seroma					
Yes	19	4.7	23	4.0	0.6972
No	396	95.3	562	96.0	

2: Chi-square test with Yates correction; 3: Fisher's exact test

Table 2: Comparison between type of operation and complications.

Table 3 shows the comparison between the operative techniques, LA and TULLA, in relation to hospital stay in days.There was statistical significance in this comparison (p-value less than 0.05). Thus, the length of hospital stay is superior in the LA group when this is compared to the group undergoing to TULAA.

Regarding the time of return to work activities (Table 4), most patients undergoing to LA or to TULAA had early return to activities (until seven days).There is no statistically significant difference among the groups LA and TULLA in relation to the time of return to work activities (74.8% and 76.3%, respectively).

	Type of operation						
	LA			TULAA			
Hospital stay (Days)	Average	SD	Median	Average	SD	Median	p-value
	2.2	1.4	2.0	2.1	1.4	1.5	0.003[1]

SD: Standard deviation; 1: Mann-Whitney test

Table 3: Comparison between type of operation and hospital stay.

	Type of operation				Total	p-value	OR	IC95%
	LA		TULAA					
	N	%	n	%				
Return to work activities (Days)								
< 7	311	74.8	447	76.3	758	0.4141	1	
From 8 to 14	84	20.3	102	17.5	186		1.2	0.8 to 1.7
>14	20	4.9	36	6.2	56		0.8	0.4 to 1.5

Table 4: Comparison between type of operation and return to work activities.

	LA		TULAA		
	n	%	n	%	p-value
Total procedures	415	100.0	585	100.0	
Total conversion					
Yes	42	10.1	69	11.7	0.5221
No	363	89.6	510	86.4	
Technique					
LA	0	0.0	12	17.4	
TULLA2	0	0.0	16	23.2	
Total laparotomy	42	-	41	-	
Babcok	24	57.1	26	37.7	0.7191
Median	18	42.9	15	21.7	

Source: research data, 2011.

1: Chi-square test with Yates correction

Table 5: Description of the conversion technique in relation to the type of operation.

Table 5 presents the description of the conversion technique in relation to the type of operation. From the 42 patients who underwent to LA, which resulted in conversion, in 24 (57.1%) was used Babcok laparotomy and 18 (42.9%) were submited to a median laparotomy. Regarding the 69 patients who underwent to TULAA and required conversion, 12 (17.4%) were converted to LA, 16 (23.2%) to video-assisted appendectomy with two incisions (TULAA2), 26 (37.7%) to Babcok laparotomy and 15 (21.7%) to median laparotomy.

Table 6 shows the descriptions of the conversion in relation to the type of operation and motive of the conversion.

Motive of conversion	Type of operation			
	LA		TULAA	
	n	%	n	%
Total	69	100.0	42	100.0
Bleeding	8	11.8	3	7.1
Dense inflammatory adhesions	23	33.8	21	50.0
Retrocecal appendix	3	2.9	0	0.0
Retroileal appendix	0	0.0	2	4.8
Subserosal appendix	4	5.9	1	2.4
Necrotic appendix	16	23.5	0	0.0
Perforated appendix	11	16.2	13	30.9
Diffuse peritonitis	3	4.4	0	0.0
Laceration cecal	1	1.5	1	2.4
Thermal injury ileal	0	0.0	1	2.4

Table 6: Descriptions of the conversion in relation to the type of operation and motive of the conversion.

Discussion

In the early 1980s, the laparoscopic technique was incorporated into the therapeutic armamentarium of appendicitis [8]. After 30 years the introduction of the laparoscopic approach to acute appendicitis, the real advantages of this approach compared with conventional appendectomy are still discussed. The clear and consistent benefits observed in other procedures performed by laparoscopy, such as cholecystectomy and surgery of gastroesophageal reflux, are not so well evidenced for the removal of the appendix [9-13].

Within the context of uncertainty about which surgical treatment is more effective and safe for acute appendicitis and considering the satisfactory results of TULAA in pediatric patients [14-16], TULAA was introduced as surgical option in adolescents and adults [5,6,17].

Based on the literature video-assisted method provides some attractive: it explores the entire abdominal cavity, providing accurate diagnosis and complete and effective cleaning of the cavity; requires only a diagnostic laparoscopy to locate, take off and exteriorize the appendix, assisted in vision and image magnification and does not require special materials that raise the costs [5,14,18-20]. The appendix, after exteriorized, is removed by conventional technique, enshrined for its safety, ease, speed and low cost. Because it is a minimally invasive method, with only a small umbilical incision, favours early indication in atypical or doubtful cases, and may contribute to the reduction of complicated forms of acute appendicitis. It provides excellent cosmetic result.

By consulting the extensive body of works comparing the LA with the conventional laparotomy, in most of these studies it was observed that operating time is higher in the laparoscopic approach [3,9,12,21,22].

Two studies that compared three techniques for appendectomy, video-assisted, laparoscopic and conventional, using two or three incisions on video-assisted approach, showed that surgical time is smallest in video-assisted method compared to laparotomy and laparoscopy [18,20]. In TULAA, the prime time is performed outside the abdominal cavity through the conventional technique, consecrated by the speed and simplicity. It is safe to say that this detail definitely contributes to reduce the duration of the video-assisted procedure compared to the higher complexity of the LA.

There is a significant decrease in the amount of analgesics administered from the first day after surgery to the second day, after LA [23,24]. The TULAA favors shorter exposure to pneumoperitoneumand demands lower inflation pressure when compared to the laparoscopic approach. This helps decrease the pain from diaphragmatic irritation and distension. This possibility has not found support in the results of this study. The diaphragmatic irritation may be more associated with the Trendelenburg position than to the time of exposure to pneumoperitoneum.

The number of small incisions in LA compared with the only portal in TULAA did not influence the occurrence of postoperative pain. Blinman [25] showed that the laparotomy incision causes greater tension and pain when compared to the combination of the small laparoscopic incision.

Studies comparing LA versus laparotomy reported incidence of postoperative complications between 0% to 16.0% for the laparoscopic group and 3.0% to 21.0% for the conventional procedure. In most of these series no mortality [1-4,11]. Regarding the TULAA in adolescents and adults, the few publications showed an incidence of postoperative complications between 4.2% to 11% [6,17,26]. In all publications, the mortality rate was zero. Lima et al. [5] analysing 300 patients undergoing TULAA, reported an incidence of 6.6% of postoperative complications and there were no deaths.

Konstadoulakis et al. [23], when comparing the TULAA with two portals with laparoscopic appendectomy, reported similar morbidity, 10% and 10.8% respectively.

In the present study, putting in perspective the wound infection, there was no statistically significant difference between the AL and TULAA. In laparoscopic technique there is greater protection of abdome wall about the possibility of contamination. This way, the inflamed appendix is removed inside the trocar or protected by suitable device for avoiding direct contact with the wound.

The maximum contact between the ignited specimen and the edges of the incision and the excessive retraction of the appendix were avoided to ensure best results regarding parietal complications in TULAA. This objective is achieved when the cecum mobilization is performed in those situations of less comfortable exteriorization of the appendix. Other measures include meticulous hemostasis and copious irrigation of the wound. Begin 14 adds to these measures the instillation of topical antibiotic in the umbilical wound. This author

emphasizes that in this region the fat layer is slightly thicker, reducing the chances of accumulation of secretions.

Some studies suggest that the incidence of intra-abdominal abscess in postoperative period is higher after laparoscopic appendectomy compared with the open technique, when both techniques are made to complicated acute appendicitis [3,27,28]. Strickland and Martindale [27] led review of literature with the goal of identifying potential causes related to increased incidence of intra-abdominal infection after laparoscopic procedures. These causes are related to the direct effects of pneumoperitoneum on peritoneal defense systems. The incidence of intra-abdominal abscess in this series, showed no statistical association comparing the techniques studied.

The TULAA by needing of lower exposure time to pneumoperitoneum compared to LA could potentially cause fewer changes in the peritoneal defenses, and thus maintain its advantages in relation to the immune system and reduce infectious complications intracavity. However, this possibility was not observed in this study. But, analyzing the five cases of intra-abdominal abscess in TULAA in four cases there was a need for conversion to conventional surgery. In the eight patients who developed abscess intracavity in LA, in just two cases the procedure was converted.

The TULAA by incorporating the principles of minimally invasive surgery, provides the conditions for achieving short period of hospitalization and length of earlier return to work activities as the laparoscopic technique. This benefit arises from the reduced surgical trauma, less postoperative pain and early mobilization.

The main cause of conversion of both techniques compared in this study was due to dense inflammatory adhesions followed by severe forms of appendicitis. The appendicular plastron is the biggest challenge in video-assisted and laparoscopic removal of the appendix. It is because the absence of cleavage plane with the adjacent viscera, difficulty of exposure without breaking the inflamed organ when it is tractioned and friability of the appendiceal base. Similar findings were reported in the literature [6,9,19,20,22].

Agresta et al. [29] commented that the conversion should not be seen as failure and the decision regarding the procedure to be chosen in the continuation of the operation must take into account the surgeon's experience in laparoscopic therapy, the evolutionary stage of the disease and the technological resources available.

This research, by original initiative, its great series and results, seeks to encourage prospective comparative studies. Currently there are no conditions to define a gold standard technique for treatment of AA. In this scenario, it would be wiser to try to determine the best access route as the initial approach of choice or option in the management of AA, which involves the confirmation of the diagnosis and treatment of disease. The effectiveness and safety of TULAA, associated with the attractiveness of this technique may make it the preferred choice in the initial management of patients with AA.

Disclosures

Drs. Geraldo José de Souza Lima, Rodrigo Fabiano Guedes Leite, Gustavo Munayer Abras, Livio José Suretti Pires, Eduardo Godoy Castro and Alcino Lázaro da Silva have no conflicts of interest or financial ties to disclosure.

This paper does not present any conflict of interest that will arise after its submission and before its publication.

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