

The type of specimen retrieval in laparoscopic appendectomy affects wound infection



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AIM: To evaluate the role of laparoscopy in appendicitis and importance of wound protection in this sense.

MATERIALS AND METHODS: Data of 506 patients operated on by either open or laparoscopic appendectomy within the last four years were evaluated retrospectively for wound infection rates. Those had laparoscopic surgery were also subgrouped and analyzed in terms of retrieval type of the specimen.

RESULTS: Wound infection rate was 5.7% for open appendectomy and zero for laparoscopic appendectomy in minimal or non-inflamed cases. For suppurative appendicitis and gangrenous or perforated cases wound infection rates were 9.1% versus 17.6% for open appendectomy versus laparoscopy. Laparoscopy without wound protection increased these rates to 17.9% versus 50%, where as wound protection reduced both to zero.

DISCUSSION: Laparoscopy itself was protective for wound infection in non-inflamed or minimally inflamed appendectomy cases with respect to open surgery. However, for suppurative, gangrenous or perforated appendicitis, laparoscopy protects from wound infection only when contact of the specimen with incisions was avoided.

CONCLUSION: Laparoscopy reduces wound infection rates in appendectomy. This advantage is prominent especially wound contamination with the specimen is prevented anyway. Using a glove finger, as a tissue bag for the retrieval of the specimen has been our favorite method that we defined as "reverse cover-up technique".

KEY WORDS: Glove bag, Glove finger, Laparoscopic appendectomy, Specimen retrieval, Tissue bag, Wound protection

Introduction

With the increasing experience in laparoscopic surgery, almost all abdominal operations are being performed laparoscopically today. In this sense, laparoscopic appendectomy (LA) for appendicitis, the most frequent acute surgical pathology of gastrointestinal tract has been the center of attraction for many surgeons along the last two

decades. Although open appendectomy (OA) is one of the basic operations that surgeons are familiar with, laparoscopy offers additional confirmation for diagnosis and easy access especially in obese patients¹⁻³. As LA is performed through relatively smaller incisions with respect to OA, wound infection may be expected to be less. However there is debate in surgical literature in terms of protective effect of laparoscopic approach for appendicitis against wound infections³⁻⁵. Besides, many surgeons oppose to LA even in today's era of laparoscopy due to high cost grounds. We dealt with some technical modifications during the early course of our learning curve to fasten and cheapen the entire operation process but especially bagging the specimen to avoid port site infections.

In this study we aimed to discuss our outcomes of LA in terms of port site infections with or without using

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tissue protection. What we observed is that, protecting tissue-appendix contact in any way prevents surgical site infection evidently in LA. Herewith we also would like to point to the new, easy and cheap technique we mostly use to bag the appendix in LA that we published a while ago; so called "reverse cover-up technique" ⁶.

Materials and Methods

Data of patients who underwent open or laparoscopic appendectomy within the last four years at our university hospital were examined retrospectively. The effect of type of surgery (open or laparoscopic) and technique used for retrieval of the specimen in LA on wound infection was questioned. Patients were grouped into open (OA) or laparoscopic (LA) surgery groups. LA group was then sub-grouped according to any tool type used for retrieval of the appendix. All the patients' data were reviewed for demographics and presence of wound infection following surgery. The presence of wound infection was considered when a cellulitis or swelling with purulent discharge around surgical incision was observed post-operatively. All the patients operated on for acute or chronic appendicitis were enrolled in the study. Pregnancy was not considered as an exclusion criterion. Patients with concomitant extra-appendiceal intra-abdominal infectious foci were excluded. Patients were assessed for possible risk factors like obesity, diabetes and steroidal drug used.

The relation between type of the surgery and presence of wound infection in different infectious conditions of

the appendix was assessed. Patients' data were clustered into three main groups in terms of infectious condition of the appendix excised. This grouping was done according to the observations of the surgeons in terms of presence of gangrene or perforation in the appendix and infectious state of the surrounding tissue in combination with the pathology report of the specimen. So, specimens were grouped as; Minimally inflamed or non-inflamed appendix, suppurative acute appendicitis without gangrene or perforation, and gangrenous or perforated acute appendicitis. Patients who had LA were also sub-grouped according to the type of tools used as wound protectors and assessed in terms of the effect of any protector tool on wound infection. The relation between type of surgery and presence of wound infection in different infectious conditions of appendix was calculated by chi-square and Fisher's exact tests of univariate analysis. Sub-group analysis was also done to demonstrate the effect of tool type used in LA to remove the specimen. Demographics and patient characteristics were compared by t-test analysis. SPSS® Statistics program version 23.0 for Mac (IBM®, Chicago, USA) was used to calculate statistical analysis. Statistical significance was accepted when p value <0.05 .

Results

A total of 516 appendectomies were performed. Ten cases demonstrated intraabdominal concomitant infectious foci such as tubal abscesses or colonic diverticulitis and were excluded. Among the rest, 368 (73%) had open

TABLE I - The distribution of the group of patients according to inflammation of appendix, type of surgery and their relation with wound infection rates. (p^* shows statistical association between OA and any kind of LA; p^{**} shows relation between LA with or without protection)

Inflammation of appendix / severity of appendicitis	Type of surgery	Total no. of patients	No. (%) of patients with wound infection	p^*	p^{**}
Minimally inflamed or non-inflamed appendectomy	OA	70	4 (5.7)		
	LA	29	0	0.189	
	LA with protection	19	0	0.286	
	LA without protection	10	0	0.438	–
Suppurative acute appendicitis	OA	230	21 (9.1)		
	LA	88	5 (5.7)	0.13	
	LA with protection	60	0	0.015	
	LA without protection	28	5 (17.9)	0.147	0.0007
Gangrenous or perforated acute appendicitis	OA	68	12 (17.6)		
	LA	21	1 (4.7)	0.143	
	LA with protection	19	0	0.048	
	LA without protection	2	1 (50)	0.246	0.001

and 138 (27%) had laparoscopic surgery with the pre-diagnosis of acute or chronic appendicitis. Laparoscopy was performed with the standard of three-port technique in all cases. Open surgery was performed either by Mc Burney (93%), Rockey Davis (5.4%) or midline (1.6%) incisions. Five patents in OA group and three in LA group had interval appendectomy following 6 weeks duration of follow up with long-term antibiotics treatment for plastron appendicitis. There were two pregnant women in each group. Two cases (1.4%) were started with laparoscopy and were diverted to open surgery for technical reasons thus considered in OA group. It was noted that all the patients operated on for acute or chronic appendicitis received a 500 mg of intravenous Sefazolin sodium preoperatively as the routine prophylaxis protocol of our center. Those observed to have non-inflamed or minimally inflamed appendicitis were not

continued any antibiotics postoperatively. Patients with suppurative, gangrenous or perforated appendicitis received 7 days of maintenance treatment with same generation mostly oral (88%), rarely intravenous (12%) antibiotics.

Clinical characteristics like age, sex, duration of symptoms, body temperature, white blood count, time from emergency department to operating room for acute cases did not differ. There were no statistical significant difference in between groups in terms of accompanying medical issues predisposing wound infection, like obesity (Body mass index >30 kg/m²), diabetes or steroidal drug use for any reason ($p>0.05$ for all).

There were no differences in the ratio of patients applied OA versus LA for minimally inflamed/non-inflamed (70.7% versus 29.3%), suppurative (72.3% versus 27.7%) and gangrenous/perforated (76.4% versus 23.6%) appendectomies ($p>0.05$).

We observed that 5.7% of the patients who had OA with specimens revealing minimal or no inflammation developed wound infections. Patients who had laparoscopic appendectomy for similar pathology did not exhibit any wound infection. Although this difference in wound infection results in between OA and LA seems to be clinically important, it was not statistically significant ($p=0.18$). There were no manifest differences between two groups in terms of wound infection rates (9.1% in OA and 5.7% in LA) for suppurative acute appendicitis cases ($p=0.13$). LA with protection significantly reduced wound infection rate to zero in patients with suppurative appendicitis ($p=0.015$). LA did not prevent wound infection enough without using any tool for specimen retrieval ($p=0.0007$). Similarly, LA did not

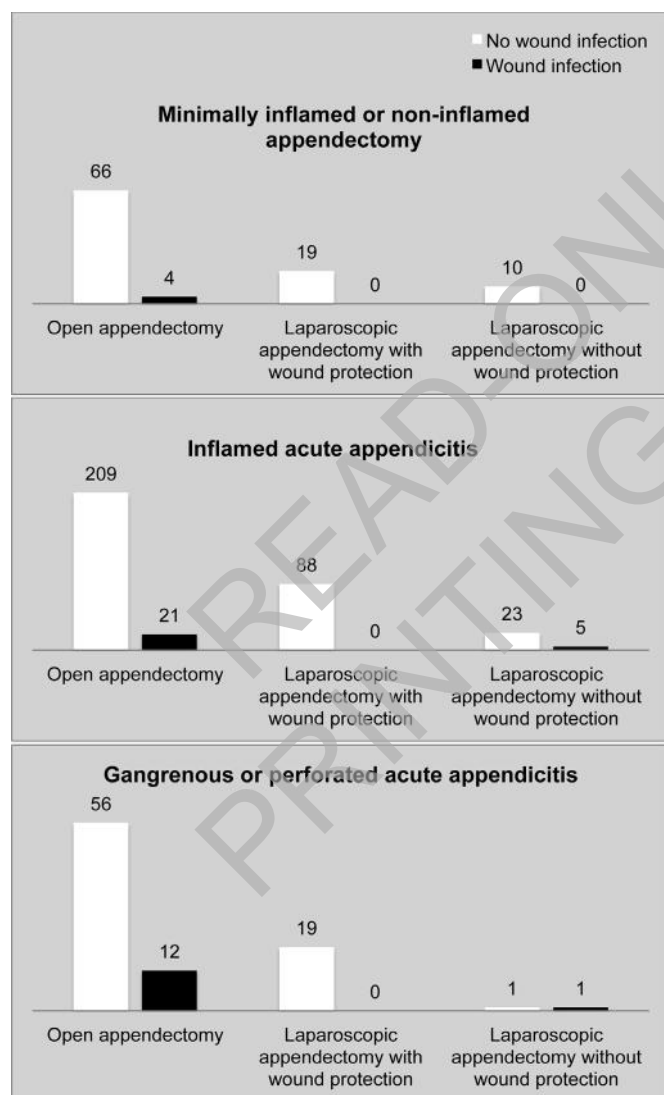


Fig. 1: Wound infection status in patients operated on with open or two different laparoscopic techniques for distinct severity of appendicitis.

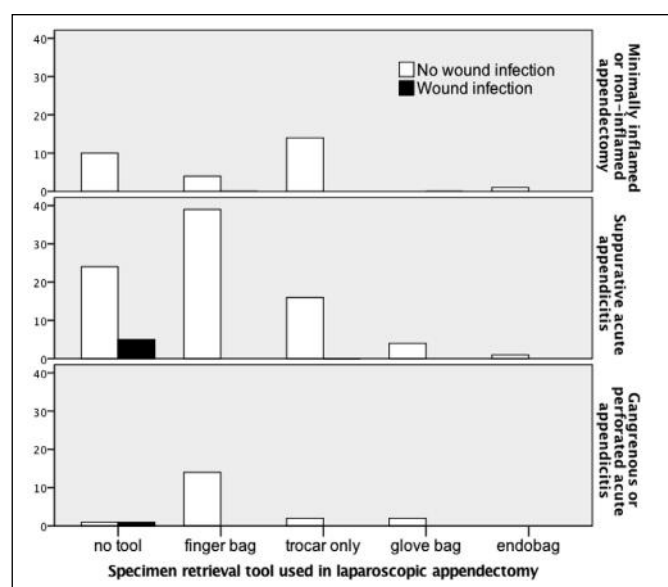


Fig. 2: Relation between wound infection and type of tools used to retrieve the specimen in LA.

make any advantage avoiding wound infection in gangrenous or perforated acute appendicitis cases if tissue protection was not ensured ($p=0.14$). In this sense, wound infection rate was demonstrated to be 17.9% in OA and 50% in LA without protection. Wound protection eliminated wound infection in this group of patients with gangrenous or perforated appendicitis with respect to OA and LA without caring protection ($p=0.048$ and 0.001 respectively). Overall wound infection rate independently from appendix pathology was 10% for OA, 4.3% for LA, 15% for LA without wound protection and zero for LA with wound protection. The distribution of the group of patients according to appendix pathology, type of surgery and wound infection rates is summarized in Table I and comparatively schematized (Fig. 1). Sub-group analysis of the patients who had LA in terms of tools used to retrieve the specimen revealed that trocar was the leading protector tool used in patients with minimally inflamed or non-inflamed appendix (73.6%) and finger bag in those both with suppurative acute appendicitis (65%) and gangrenous or perforated acute appendicitis (76.4%). All the wound infection cases following LA were those without wound protection. Sub-group analysis demonstrated that type of the tool used to retrieve the specimen did not matter on wound infection occasion and all worked well (Fig. 2).

Discussion

Logically, an infected, swelled and fragile appendix that is enforced to be retrieved through a one cm port site may lead to contamination of the neighboring tissue and cause wound infection. However, there are challenging results concerning LA in terms of wound infection^{1, 7-11}. In a prospective randomized trial, wound infection was reported to be significantly less in the LA group⁹. Xiao et al analyzed the data of 16263 patients in a multicenter cohort study and published their results in favor of protective effect of LA for wound infections⁷. However, Rohr et al¹⁰ declared more frequent wound infections in the LA group. Mantoglu et al¹¹ reported two cases (6.5%) with port site wound infections in LA group which made no sense statistically with respect to OA group.

LA may be advantageous to avoid wound infection due to relatively short incisions used and less disturbed muscular integrity. This advantage may not be adequate to prevent infections if precaution is not taken for tissue contamination. Unsurprisingly an infected, especially gangrenous or perforated appendix may cause surgical site infections. Any study questioning the role of LA on surgical site infections must standardize the retrieval type of the appendix. The discordance in the literature regarding the protective effect of LA on wound infection may be due to the un-standardized nature of most of the studies in terms of bagging processing of the

specimen. Wound infection rates of OA in our center was found to be similar with the literature^{9,12}. However, neither our study nor most of the papers in the literature standardize any type of wound protection in OA that may affect infection rates. Through out the last four years of our clinical practice, LA had been the preferred choice of one third of the surgeons in our institute and OA had been the only choice of the rest. This condition led the operation planning of almost all of the cases regardless of patient characteristics. Thus, preoperative any diagnose of acute or perforated appendicitis or any comorbidity that may affect postoperative wound infection did not make any sense in terms of selection of the type of surgery (open or laparoscopic) in our study. Therefore we predict that all the patients treated either with OA or LA were equally disturbed in turns of predisposition to wound infection except the impact of operation technique itself, avoiding any selection bias. Consequently, we thought it was appropriate to make such a comparison between OA and LA results in terms of wound infection rates.

Our results showed that LA helps better to prevent wound infection than OA. Moreover, this effect is much prominent when care is taken to prevent any contact of the infected specimen with the port site. This protection can be provided either by using any kind of industrial or hand made tissue bags or a one cm trocar house, if the specimen fits in. As expected, LA has also been demonstrated in our study to eliminate the possibility of wound infection that is rarely seen in non-inflamed appendectomies^{12,13}. LA, even not supported with tissue protection reduced the wound infection risk with respect to OA in our study. Although not significant statistically, this result is clinically important. LA may be advantageous against wound infection in case of insensible appendix inflammation status due to its resistant structure of relatively shorter incisions. There are numerous tools that can be used as protective bags. The two practical but expensive instruments used are industrial type wound protectors and industrial type of bags. Hand made gloves and glove fingers are the two most commonly used ones for the retrieval of the appendix. They are practical, accessible and cheap. Yet, hand-made glove bags may sometimes be too bulky for a one cm incision especially in obese patients with a considerable thickness of subcutaneous tissue. On the other hand those, made of glove fingers may sometimes be patience consuming while trying to place a bulky appendix in. The "reverse cover-up" technique which most of our surgeons prefer to use is already a fast and easy way of bagging any sort of appendix⁶. Another tool mentioned in the literature to be suitable for bagging the appendix is a condom, which we believe is not as durable as a latex surgical glove and needs to be sterilized before its use. Certainly, one of the most important determinatives to avoid

wound infection in LA using any type of tissue bag is to pay attention not to touch the outer layer of the bag that will touch the wound soon, with any infected surface. The "reverse cover-up" technique, we believe is the most appropriate one for this aforementioned situation.

Retrospective nature of the study and limited number of patients in LA without protection for gangrenous or perforated acute appendicitis group are the limitations of our work. The latest situation diminished the power of the statistical analysis, anyway, it is not logic to retrieve an evidently infected tissue without any tissue protection, which we also criticize our relevant surgeons for.

Conclusions

Finally we conclude that laparoscopy helps to avoid wound infections in appendectomy cases and this advantage increases manifold by preventing wound contact of the specimen. This situation can be achieved by using any kind of tissue bags or retrieval within a one cm trocar at least, if possible, in all laparoscopic appendectomies especially for infected cases. We also emphasize that, using glove finger is a cheap, easy and safe method for retrieving the specimen in LA, which we did not encounter any problems with.

Riassunto

Lo scopo dello studio è quello di valutare il ruolo della laparoscopia nell'appendicite e l'importanza della protezione della ferita. Lo studio è di tipo retrospettivo, condotto su 506 pazienti sottoposti ad appendicectomia ad addome aperto o in laparoscopia negli ultimi quattro anni, per individuare l'incidenza dell'infezione della ferita. Il gruppo degli operati con laparoscopia è stato suddiviso in due sottogruppi secondo il metodo adottato per l'estrazione del pezzo operatorio.

Nei casi di flogosi minima o assente l'incidenza dell'infezione della ferita è stata del 5,7% nelle appendicectomie ad addome aperto e nullo per quelle condotte in laparoscopia. Nelle appendiciti suppurate, gangrenose o perforate l'incidenza dell'infezione della ferita è stata del 9,1% e 17,6% rispettivamente per le appendicectomie ad addome aperto e quelle laparoscopiche. Nelle appendicectomie laparoscopiche senza protezione della ferita l'incremento dell'incidenza delle infezioni è stato dal 17,9% al 50% rispettivamente negli interventi ad addome aperto o laparoscopico, mentre la protezione della ferita in entrambi i casi ha dato in entrambi i casi un'incidenza nulla.

La laparoscopia si è dimostrata più protettiva nei confronti dell'infezione della ferita nei casi di flogosi mini-

ma o assente rispetto alla chirurgia ad addome aperto. Invece nelle appendiciti suppurative, gangrenose o suppurate la laparoscopia è protettiva dell'infezione della ferita soltanto se si evita il contatto del pezzo operatorio con l'incisione.

In conclusione la laparoscopia riduce l'incidenza dell'infezione della ferita nell'appendicectomia. Questo vantaggio è evidente se si evita la contaminazione con il pezzo operatorio. L'uso di un dito di guanto come borsa per l'asportazione del pezzo operatorio è stato il metodo da noi privilegiato, da noi definito tecnica "reverse cover-up".

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