Reduced wound infection in colorectal resection by using a wound auto-retractor

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SUMMARY

Surgical site infection (SSI) remains an important problem in colorectal surgery. The aim of this study is to determine whether the use of a wound protection system can be effective in reducing the incidence of wound infection after colorectal resection. Ninety-five consecutive patients underwent colorectal resection, carried out by one single surgeon during a six-year period (2009-2015). A laparotomy auto-retractor was used in all cases (Alexis Wound Retractor; Applied Medical, Rancho Santa Margarita, CA). Forty-two resections (44%) were made by laparoscopy. Anastomoses for laparoscopic right colectomies, section of left colon and insertion of the anvil of CEEA for laparoscopic left colectomies were made extracorporeally. No colon cleansing was used in 67 patients (72%). The median age for those undergoing colectomy was 67 (range 41-90). The median Body Mass Index was 25.04 (range 18- 36.76). Three patients (3%) were operated on an emergency basis because of bowel obstruction or perforation. Fifty-three patients were classified ASA I-II (56%). There were six re-operations, for anastomotic dehiscence, peri-ostomal cellulitis and postoperative bleeding. The median postoperative stay was eight days (range 3-28). Only one patient (1%) developed wound infection. Due to the significantly reduced incidence of postoperative wound infection, this study suggests that the Alexis retractor be considered for routine use.

Keywords: wound infection, colorectal resection, wound retractor.

INTRODUCTION

Surgical site infection (SSI) remains an important problem in gastrointestinal surgery, especially in colorectal operations. Wound infection following gastrointestinal surgery results from intra-operative inoculation of a bacterial load into the wound tissues that the immune system is unable to control. From a theoretical point of view, wound protectors must minimize the intra-operative bacterial inoculum in the opened abdominal wall, as demonstrated by Raahave [1]. Any mechanism that may avoid or decrease the possibility of bacterial inoculation would contribute to the prevention of wound infection.

The introduction of intestinal antisepsis and antibiotic prophylaxis in the 1970s became a milestone in the evolution of infection limitation in general surgery. Surgical wound infection decreased dramatically in colorectal surgery from rates of over 50% to rates between 2 and 20% [2-25]. Nonetheless, in the last 30 years no further progress has been made in this field of knowledge. From the Eighties until now, the rates of surgical wound infection in colorectal surgery have not changed [26-49]. However, some recent reports on procedures using protector barriers suggest these could potentially improve the results [50-52]. The aim of our study is to determine whether the use of

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a wound protection system can be effective in reducing the incidence of wound infection after colorectal resection.

MATERIAL AND METHODS

A prospective observational study has been made over 95 consecutive patients who underwent colorectal resection, by one individual surgeon (JJA). A laparotomy auto-retractor was used in all cases (Alexis Wound Retractor; Applied Medical, Rancho Santa Margarita, CA) (Figure 1). Alexis wound retractors provide 360° of atraumatic, circumferential retraction and reduce the need for hand-held retractors. On the other hand, the hermetic isolation of the wound tissues from the intra-abdominal surgical field provides a physical barrier that diminishes the possibility of wound contamination by gastrointestinal bacteria. Alexis O-Ring consists in two stiff rings with a polyurethane cylinder in between the two rings. The inner ring is positioned within the peritoneal cavity. The outer ring is rolled up until it is taut circumferentially around the wound.

We decided to start this prospective study after observing no previous cases of infection by using the wound retractor in several gastrointestinal operations. For ethical reasons, we have not included a control group, taking in account that our figures for wound infection in patients who underwent colorectal resection following the actual standard methods have been 17% in the last years. These results are similar to those reported in recent studies.

Figure 1 - Alexis Wound Retractor.

Preoperative antibiotic prophylaxis was given to all patients. Antibiotic prophylaxis was administered during anaesthetic induction (intravenous cefotaxime 2g and metronidazole 1g). No oral antibiotics were given. Patients received standard care during surgery (no normothermia). No antibacterial-coated sutures were used for laparotomy closure. Section of the colon and anastomosis for laparoscopic right colectomies, section of left colon and insertion of the anvil of CEEA for laparoscopic left colectomies were made extracorporeal. Colon cleansing was used for rectal surgery, but not for colon resection. The Alexis retractor was placed immediately after opening the peritoneum. On closing the laparotomy, gloves were changed and no previously used needle holders, forceps, and separators were used. The surgical wound was washed with 500 mL of normal saline after peritoneal closure. Incisions were inspected daily until the day of discharge. All wounds were revised in the outpatient clinic at 30 postoperative days.

Factors analyzed have been age, sex, body mass index (BMI), TNM stage for cancer, American Society of Anaesthesiologists grade (ASA), diagnosis, surgery, complications and length of postoperative stay in hospital. The principal variable of the study was wound infection, both deep and superficial. For defining the occurrence of wound infection, the criteria of the Centres for Disease Control and Prevention (CDC) Hospital Infection were used. Statistics: data were analyzed with the program StatView® for Macintosh.

RESULTS

Table 1 shows the description and results of the series. The median age of the series was 67 years (range (41-90). The median of Body Mass Index was 24.2 (range 18-33.9). Forty-two patients (44%) were female. Three patients (3%) were operated on in an emergency because of intestinal obstruction (two cases) or perforation (one case). Seventy-seven patients (81%) were operated on for colorectal cancer. Fifty-three patients (56%) were classified grade ASA I-II (56%) and 42 grade ASA III-IV (44%). Resection was made by laparoscopy in 42 patients (44%), by mini-laparotomy in three

Table 1 - Description of the series.

Analysed factors	*Number of cases*
Age, years (median)	67 (range 41-90 years)
Sex	
Male	53 (56%)
Female	42 (44%)
BMI (median)	25.04 (range 18- 36.76)
ASA grade	
I-II	53 (56%)
III-IV	42 (44%)
Diagnosis	
Colorectal cancer	77 (81%)
Villous adenoma	8 (8%)
Diverticular disease	7 (7%)
Other	3 (4%)
TNM stage of colorectal cancers	
I	16 (21%)
II	40 (52%)
III	13 (17%)
IV	8 (10%)
Type of surgery	
Elective	92 (97%)
Emergency	3 (3%)
Surgical technique	
Right colectomy	40 (42%)
Left colectomy	24 (25%)
Anterior resection- abdominoperineal excision	27 (29%)
Pan-proctocolectomy	1 (1%)
Subtotal colectomy	2 (2%)
Other	1 (1%)
Access to de abdominal cavity	
Formal laparotomy	50 (53%)
Mini-laparotomy	3 (3%)
Laparoscopy	42 (44%)
Type of laparotomy	
Transverse	53 (56%)
Middle line	42 (44%)
Colon cleansing	
Yes	26 (27%)
No	69 (73%)
Morbidity	
Wound infection	1 (1%)
Anastomotic leak	5 (5%)
Intraabdominal abscess	2 (2%)
Sepsis	5 (6%)
Intraabdominal bleeding	1 (1%)
Adynamic ileus	3 (3%)
Respiratory failure	3 (3%)
Deep vein thrombosis	2 (3%)
Pneumothorax	1 (1%)
Reoperation	6 (6%)

cases (3%) and formal laparotomy in 50 (53%). No bowel cleansing was used in 69 patients (73%). Mean duration of surgery for colon resections was 120 minutes (range 65-300), and 190 minutes (range 120-350) for rectal surgery. There were six re-operations, four for anastomotic dehiscence, one for postoperative intra-abdominal bleeding and another one for peri-ileostomy cellulitis. The median postoperative stay in hospital was eight days (range 3-34). Only one cirrhotic patient (1%) showed infection of the surgical wound, secondary to peri-ileostomy cellulitis that finally invaded the laparotomy wound. The patient subsequently died as a consequence of hepato-renal failure.

DISCUSSION

In spite of the medical advances in the last decades, the rates of wound infection in colorectal surgery remain surprisingly high [20-31].

Surgical wound infection in colorectal surgery is a consequence of intraoperative contamination of the abdominal wall tissues. With the purpose of avoiding intra-operative contamination and to control postoperative infection, a variety of methods have been traditionally employed. Some pursue the aim of reducing the number of bacteria in the large bowel by cleansing of the colon in their different modalities and/or by using preoperative oral antibiotics (intestinal antisepsis); others provide a high concentration of antibiotics in the tissues at the time of bacterial contamination (antibiotic prophylaxis).

With the introduction of intestinal antisepsis and antibiotic prophylaxis in the 1970s-1980s (Tables 2 and 3), there was a dramatic decrease in the rates of wound infection in colorectal surgery [2-25]. Figures fell from 50%-60% to 2%-20%. Unfortunately, thirty years later, no further improvement has been made. The rates of wound infection following elective colorectal surgery reported in recent years are typically around 20% [26-49] (Table 4). The current high rate of wound infection may be related to the increase in the age of patients and their co-morbidities, when compared with those of the 1970s and 1980s.

From a theoretical point of view, any mechanism directed towards avoiding the intra-operative bacterial contamination during surgery of the abdominal cavity could result in a reduction of the

Table 2 - Rates of wound infection in colorectal surgery by using oral antibiotic bowel preparation in the1970s-1980s (intestinal anti-sepsis).

Author, year	*Antibiotic*	*Days*	*Patients*	*%*
Sellwood et al., 1969 [2]	phthalyl-sulfathiazole+neomycin bacitracine + nistamine	4 2	16 19	62 21
Everett R.A., 1969 [3]	neomycin	4	13	61
Judd et al., 1975 [4]	neomycin neomycin + tetracycline	2 2	68 65	41,2 4,6
Condon et al., 1975 [5]	neomycin + erythromycin	1	174	2,3
Stone et al., 1976 [6]	neomycin + erythromycin	2	43	2,3
Molin et al., 1979 [7]	neomycin + oxitetracycline	1	75	12
Taylor et al., 1979 [8]	thalazole metronidazole + thalazole	4 1	59 61	49,2 13,1
Hagen et al., 1980 [9]	metronidazole	1	17	11,8
Cainzos et al., 1982 [10]	neomycin + erythromycin	1	97	42,3
Cohn et al., 1982 [11]	kanamicina	1	652	9,5
Keighley et al., l982 [12]	neomycin + metronidazole kanamicina + metronidazole	2 3	51 47	17 36
Edmonson et al., 1983 [13]	neomycin + erythromycin	1	58	1,7
Hinchey et al., l983 [14]	neomycin + metronidazole neomycin + erythromycin metronidazole	2 1 2	39 40 39	5 25 2,5
Condon et al., 1984 [15]	neomycin + erythromycin	1	540	5,6
Peck et al., 1984 [16]	neomycin + aminoglycoside	-	124	4
Figueras et al., 1984 [17]	neomycin + erythromycin	1	45	4,5
Arenal et al., 1988 [18]	neomycin + erythromycin	3	42	9,5

Table 3 - Rates of wound infection in colorectal surgery by using intravenous antibiotic prophylaxis in the1970s-1980s.

Author/year	*Antibiotic prophylaxis*	*Patients*	*%*
Keighley et al., 1976 [19]	lincomycin	33	12
Condon et al., 1979 [20]	cephalothin	67	30
Lindhagen et al., l98l [21]	metronidazole + fosfomycin metronidazole + cephalothin	30 28	6,6 10
Keighley et al., 1982 [12]	lincomycin lincomycin + tobramycin metronidazole + kanamycin metronidazole + gentamycin cefoxitin metronidazole + gentamycin metronidazole	31 30 46 35 37 46 50	12 13 6 26 24 24 28
Hinchey et al., 1983 [14]	metronidazole	39	7,7
Bell et al., 1983 [22]	erythromycin metronidazole	47 51	10,6 10.0
Marti et al., 1983 [23]	clindamycin + gentamycin metronidazole + gentamycin	52 55	9.6 7.3
Edmonson et al., 1983 [13]	cephaloridine	65	12,3
Aberg et al., 1984 [24]	metronidazole doxycycline	81 76	28 21
Peck et al., 1984 [16]	cephalosporin different doses	116 130 133	18,1 6,9 5,3
Figueras et al., 1984 [17]	metronidazole + gentamycin	48	14,6
Gómez-Alonso et al., 1984 [25]	metronidazole + gentamycin	31	17

Table 4 - Rates of wound infection reported in the last years for colorectal surgery.

Author, year		*Patients*	*Rate of wound infection*
Cannon et al., 2012 [26]	No bowel preparation Mechanical bowel preparation Oral antibiotic bowel preparation	9940	18.1% 20.0% 8.3%
Hübner et al., 2011 [27]	Individual surgeon rates	-	4%-36%
Fraccalvieri et al., 2014 [28]	Vicryl plus PDS	240 240	14.6% 29.2%
Bishawi et al., 2014 [29]	Open surgery Hand-assisted surgery	195 50	22,1% 44%
Ortiz et al., 2012 [30]	Conventional group SSI reduction strategy	516 453	12.8% 17.7%
Anthony et al., 2011 [31]	Standard Evidence-based bundle intervention	104 106	36% 19%
Berenguer et al., 2010 [32]	Pre-institution of surgical care improvement project Post-institution of surgical care improvement project	113 84	13.3% 8.3%
Deierhoi et al., 2013 [33]	IV antibiotic Oral + IV antibiotic	3324 2426	16,7% 6,3%
Coello et al., 2005 [34]	Conventional surgery	67410	10%
Konishi et al., 2005 [35]	Colon resection Rectal resection	339 217	9.4% 18%
Pendlimari et al., 2012 [36]	Conventional surgery	24673	9.5%
Smith et al., 2004 [37]	Conventional surgery	176	25.6%
Nakagoe et al., 2001 [38]	Wound edge protector	28	0%
Lutfiyya et al., 2012 [39]	Standard care group Surgical care bundles	430 195	16.3% 4.1%
Connolly et al., 2015 [40]	Standard care group SSI reduction strategy	311 328	23.48% 8.04%
Tanner et al., 2016 [41]	Standard care group Surgical care bundles	3866 4649	15.1% 7.0%
Bellows et al., 2011 [42]	IV antibiotic Oral + IV antibiotic	meta-analysis	6.7% 12.1%
Baier et al., 2012 [43]	Ring drape group Control group	98 101	17.3% 21.8%
Blumetti et al., 2007 [44]	Conventional surgery	428	17%
Brasel et al., 2007 [45]	30% FiO2 80% FiO2	143 148	24.4% 14.9%
Itani et al., 2006 [46]	Ertapenem Cefotetan	451 450	12.3% 17.9%
Keenanet al., 2014 [47]	Standard care group Surgical care bundles	346 213	19.3% 5.7%
Morris et al., 2015 [48]	No bowel preparation Mechanical bowel preparation Oral antibiotic bowel preparation	2150 3779 2486	8.7% 7.0% 3.6%
Ghuman A et al, 2015 [49]	Pre-closure bundle Post-closure bundle	111 94	14.4% 14.9%

Table 5 - Rate of wound infection by using Alexis O-ring.

	Alexis Cases/infection (%)	*Control Cases/infection (%)*
Horiuchi et al., 2007	40/0 (0%)	52/7 (13.0%)
Reid K. et al., 2010	64/3 (4.7%)	66/15 (22.7%)
Cheng K., 2012	34/0 (0%)	30/6 (20.0%)

rate of wound infection. Dual ring wound-edge protectors create a physical hermetic closed barrier that reduces or avoids the accumulation of bacteria in the wound tissues. On other hand, wound retractors reduce tissue damage due to the need for using handheld retraction. Although some isolated reports about wound edge protectors reported a failure to reduce the rate of wound infection in colorectal surgery [53-56], this way has not yet been sufficiently explored. A small number of papers reporting the use of the Alexis wound retractor have been published in the last few years, with excellent results [50-52].

The low rate of wound infection in our series is in accordance with the results of recent reports of colorectal surgery using the Alexis retractor (Table 5). The rational explanation of these results is that the laparotomy retractor makes a significant contribution to diminishing or avoiding the bacterial inoculum in the tissues of the surgical wound. After more than thirty years investigating how to improve the results of wound infection for colorectal resection, without notable results, we believe that the investigation must be directed to procedures that avoid the intra-operative contamination of the wound tissues as herein described.

Due to the reduced incidence of postoperative wound infection, this study suggests that the Alexis-retractor must be considered for routine use in colorectal surgery.

Conflict of interest statement: here is not a financial relationship with the organization that sponsored the research before the reference list in our manuscript. All authors declare no commercial association that might create a conflict of interest in connection with the manuscript.

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