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Efficacy of Antimicrobial Triclosan-Coated Polyglactin 910 (Vicryl* Plus) Suture for Closure of the Abdominal Wall after Colorectal Surgery

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A B S T R A C T

This study compared Triclosan coated polyglactin 910 (Vicryl Plus) with polyglactin 910(Vicryl*) on abdominal wall healing in colorectal surgery patients. 184 patients with colorectal cancer were included in the study. In 91, the abdominal wall was closed with the Vicryl* Plus, and in 93 patients with Vicryl*. Demographic characteristics, biochemical inflammatory parameters, wound appearance, length of hospital stay, postoperative wound complications and postincisional hernia were recorded. In the Vicryl* Plus group there was a shorter hospital stay (13.2±1.3 days; 21.4±2.8 respectively). In the Vicryl* Plus group inflammatory parameters decreased to normal within the first week whereas in the Vicryl* group remained increased. In the Vicryl* Plus group four patients had a wound discharge, seven had inflammatory reactions to the skin sutures. One dehiscence was noticed. In the Vicryl* group 12 patients had an SSI, 14 patients had inflammatory reactions to the skin sutures and 7 patients had a wound dehiscence. Closure of the abdominal wall using Vicryl*Plus decreases postoperative wound complications, length of hospital stay and is associated with a more rapid return of inflammatory markers to normal.*

Key words: *Vicryl, Vicryl* Plus, abdominal wall closure, surgical site infection*

Introduction

Development of infection in incisional wounds and poor healing represent the most common complications of abdominal surgery which may also include serious life threatening complications. These complications are especially dangerous in high risk patients. Some patients are operated on electively after adequate preoperative preparation. All surgical site complications cause higher mortality, higher morbidity and extra hospital days for those patients. Many intrinsic and extrinsic risk factors may influence the process of wound healing such as skin antisepsis, operative technique, antimicrobial prophylaxis, gender, BMI and prior operative procedures[1–3]. During the past 20 years surgeons have standardized preoperative, intraoperative and postoperative procedures to maximise the reduction of surgical site infections (SSIs). All these procedures, such as correction of nutritional disorders and preoperative and postoperative protein status, antibiotic prophylaxis, skin antiseptic preparation, and adequate operative techniques are documented. Those procedures reduce the risk of intraoperative and SSIs, and significantly improve patients' outcomes.

The influence of the suture material on SSIs has been developed over the last 50 years[4,5]. During that period surgeons have shown that surgical sutures, like any other implant in human body, can cause microbial adherence and colonization. Various microorganisms may contaminate wounds posroperatively and suture material. When the sutured material becomes contaminated, local mechanisms of wound decontamination become ineffective[6,7]. Triclosan coated polyglactin 910 was developed to prevent microbial colonization of suture material in operative wounds. Some experimental published studies have shown a decrease in bacterial adherence to triclosan

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coated suture in vitro and in vivo[8–16]. Those studies evaluated contaminated suture material in conditions made to represent the surgical wound. The majority of these studies were designed in vitro, and results suggested that antibacterial-coated sutures show an inhibitory influence on bacteria placed in surgical wounds.

This current study was of clinical design and included 184 patients with colorectal carcinoma being operated on electively. The aim of the study was to compare the effect of triclosan coated polyglactin 910 (Vicryl* Plus) or polyglactin 910(Vicryl*) on abdominal wall healing in theese patients.

Materials and Methods

In a 12-month period (September 2008–September 2009), 184 patients diagnosed with colo-rectal, cancer scheduled for elective surgery, were included in the study. Ethical approval was obtained and written consent was provided by the participants.

All operations were performed in the Department of Surgery, »Sveti Duh« University Hospital, Zagreb, Croatia, by the same surgical team and the same anesthesiologist. Preoperative investigation included complete colonoscopy (with biopsy and histological confirmation of cancer), chest X-ray, ultrasonography, CT scan and relevant serum tests

All operations were performed through a midline incision. The skin was incised (15–18 cm length) with a scalpel; all other layers were transected with diathermy. Prophylactic antibiotics, gentamicin 160 mg (Gentamicin, Belupo, Koprivnica, Croatia) and metronidazole 500 mg, (Medazol, Belupo, Koprivnica, Croatia) were given intravenously during induction of anaesthesia. Wound closure was performed with a continuous single-layer mass technique (peritoneum, muscle, and fascia). 91 patients were randomised to closure with 0 Vicryl* Plus (Ethicon Johnson-Johnson) and 93 patients with 0 Vicryl* (Ethicon Johnson-Johnson).

Randomization was generated by a computer in blocks of 10. Sealed and numbered opaque envelopes containing suture packets were prepared. The envelopes were kept in the operating theatre and assigned in order.

The running sutures were 1 cm apart and 1.5 cm from the wound edge. Skin was closed with polyamide (Ethilon, 2–0, Ethicon, Johnson-Johnson). Postoperative data were collected from operation reports, nurses wound reports, chart review and microbiology reports. The patients were carefully followed throughout their hospitalization by the same surgical team and were carefully monitored with the following parameters: duration of operative procedure, duration of hospitalization, biochemical inflammation parameters (white blood cell count – WBC; procalcitonin – PCT; and C-reactive protein – CRP), presence of wound infection, dehiscence, haematoma or inflammatory reactions to the skin sutures (skin inflammation around the suture), postoperative hernias, readmissions and reoperations.

Statistical analysis

Differences between groups were compared by the χ^2 or Fisher exact test for categorical variables, the Mann-Whitney U-test for continuously variables. Data included all biographic and perioperative data as well as postoperative outcome. Results are given as absolute numbers, mean and standard deviation, or as median (range), unless indicated otherwise. The two-sample Student's t-test was used to test the hypothesis of equality of means. A p value < 0.05 was considered statistically significant.

Results

During the 12-month period (September, 2008–September, 2009) 184 patients, having elective surgery for colorectal cancer, were admitted to the study. 91 patients were randomised to have closure of their abdominal wall with Vicryl* Plus, and 93 patients with Vicryl.

Fifty three percent of the patients were male (99) and 47% (85) were female. Their mean age was 58±14.5 years in the Vicryl* Plus group and 57±14.7 years in the Vicryl group. The mean BMI of the patients was 22.7±1.6 in the Vicryl* Plus group and 22.1±1. in the Vicryl group. There was no statistical difference in demographic and preoperative data between the two groups (Table 1).

The mean operation time was 95.5±17.3 min in the Vicryl* Plus group and 91.3±15.3 min in the Vicryl group. (Table1). The mean hospitalization period was 1.2±1.3 day in the Vicryl* Plus group and 21.4±2.8 in the Vicryl group ($p<0.05$). There were no deaths in either group.

TABLE 1
DEMOGRAPHIC AND OPERATIVE DATA IN PATIENTS OPERATED ON FOR COLORECTAL CANCER

	Vicryl* plus	Vicryl*	p
Age(years)	58±14.5	57±14.7	0.9999
40–50	17 (19)	19 (21)	
50–60	31 (34)	33 (35)	
60–70	25 (27)	21 (23)	
70–80	15 (17)	17 (18)	
>80	3 (3)	3 (3)	
Gender			
m	49 (54)	50 (54)	
f	42 (46)	43 (46)	
BMI	22.7±1.6	22.1±1.4	0.9754
<20	13 (14)	13 (14)	
20–25	70 (78)	71 (77)	
>25	7 (8)	9 (9)	
Duration of surgery (min)	95.5±17.3	91.3±18.6	0.8933

data presented as n (%), significant differences ($p<0.05$) between groups*

Inflammatory biochemical parameters

Values of inflammatory parameters at baseline were not statistically significantly different between the two groups. On the first postoperative day similar procalcitonin (PCT) (0.3±0.1 mg/L) values were found in both groups. However, on the second day PCT increased in both groups, but was statistically significantly lower in the Vicryl* Plus group ($p<0.05$) and remained lower during the first postoperative week ($p<0.05$). Thereafter the PCT values normalized without any differences (Figure 1).

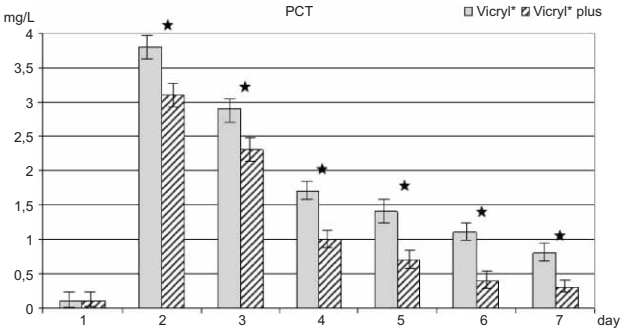

Fig. 1. Postoperative procalcitonin as a inflammatory marker. Data presented as X±SD, significant differences (p<0.05) between groups.*

Leukocyte counts postoperatively were also increased in both groups but fell continuously (without any significance during first two postoperative days). However, after the second postoperative day significantly lower leukocyte levels were found in the Vicryl* Plus group over the next three days ($p<0.05$). After the seventh postoperative day the leukocyte values were within normal range in both groups (Figure 2).

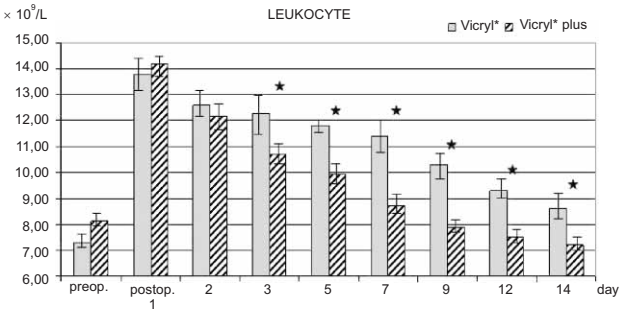

Fig. 2. Posroperative leukocyte counts. Data presented as X±SD, significant differences (p<0.05) between groups.*

CRP levels increased postoperatively in both groups but then fell to normal levels. On the second postoperative day significantly lower CRP values were found in the Vicryl* Plus group which was maintained for the next twelve days ($p<0.05$). CRP values had returned to normal in the Vicryl* Plus group by the fifth postoperative day but did not return to normal in the Vicryl * group until the 12th postoperative day (Figure 3).

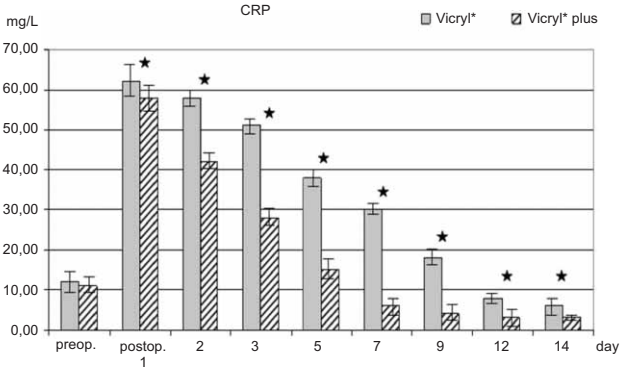

Fig. 3. Posroperative CRP levels. Data presented as X±SD, significant differences (p<0.05) between groups.*

Wound complications

Significantly less postoperative inflammatory reactions to the skin sutures were seen in the Vicryl* Plus group (7.5%), compared with the Vicryl* group (17.5%), significantly less SSIs (4.3% in the Vicryl* plus group compared with 13.2% in the standard Vicryl* group); with less dehiscences (4.3% Vicryl* plus patients compared with 13.2% in Vicryl* group). In 8.8% of the Vicryl* group patients, re-operation was necessary (in 7 patients because of wound dehiscence and in one patient because of peritonitis) whereas only 1% needed re-operation in the Vicryl* plus group (wound dehiscence). These differences in complication rates between groups is statistically significant ($p<0.05$). The difference between incisional hernia incidence was not statistically significant (5.5% in Vicryl* group compared with 2.2% in Vicryl* plus group; $p=0.235$) (Table 2).

Discussion

Poor or delayed wound healing caused by infection in incisional wounds is a serious problem after abdominal surgery and it can be sometimes characterized as being life threatening. The morbidity after SSI is expensive; relating to treatment costs including antibiotics, prolonged hospitalization, and loss of work productivity[10].

TABLE 2
WOUND COMPLICATIONS

	Vicryl plus	Vicryl	p
Inflammatory reactions to skin sutures	7 (7.5)	16 (17.5)	0.039
Presence of wound infection	4 (4.3)	12 (13.2)	0.035
Dehiscence	1 (1.1)	7 (7.7)	0.027
Re operations	1 (1.1)	8 (8.8)	0.015
Incisional hernia	2 (2.2)	5 (5.5)	0.235

data are expressed as number (%) of patients, $p<0.05$ significant differences between groups

Significant number of risk factors for inadequate wound healing is well known. Recent studies have shown significantly decreased number of SSIs after wound closure with triclosan coated polyglactin suture (Vicryl* Plus)[4–17]. Foreign material in wounds and tissue in general is recognised to increase the susceptibility of surrounding tissue to infection. It is an also known that contaminated suture material inacyivates local mechanisms of wound decontamination[8]. In consideration of this the development of an antibacterial suture has been an aim for the past two decades. Triclosan coated polyglactin 910 (Vicryl* Plus) has been developed as a result. Triclosan is a broad-spectrum antiseptic with documented safety and efficacy. It has antiseptic activity against selected Gram positive and Gram-negative bacteria[8,18].

Few recent studies suggested that sub-inhibitory or long term exposure to triclosan is not associated with diminished triclosan activity or increased antimicrobial resistance[19,20]. Although these studies suggest that the acquisition of microbial resistance to triclosan appears to be very low based on minimal inhibitory concentration data, it should be emphasized that selected microbial populations (ie, *Pseudomonas aeruginosa*) have been found to be resistant to various antiseptic agents, including triclosan. There is potential risk of bacterial resistance to triclosan activity[8].

Several studies have investigated the antibacterial activity of Vicryl* Plus in vitro and in vivo[11–16] and shown that it has no negative effect on wound healing[17,20]. It has also been shown that triclosan-coated sutures are highly effective in reducing the microbial adherence of both biofilm-forming and non biofilm-forming staphylococcal isolates to the surface of braided surgical sutures[8].

Ford and colleagues reported in 2005 that triclosan-coated polyglactin sutures decreased postoperative pain in paediatric patients[21]. No effect on wound healing was observed.

Gomez-Alonso and others have shown, in an animal model, that Vicryl* Plus antibacterial suture modulates inflammatory response to levels similar to those observed in uninfected wounds, with normalization of the tissue healing process[12].

Rozzelle and colleagues confirmed that triclosan-coated Polyglactin 910 antibacterial activity in wound closure after cerebrospinal fluid shunt surgery in humans reduced the incidence of shunt infections[22].

Justinger and others tested triclosan coated polyglactin 910 activity to prevent abdominal incisional site infections. The study included all abdominal operation performed through midline incisions. They found a reduction of poorly healing wounds after abdominal surgery and a shorter hospitalization period in patients whose incisions were closed with triclosan coated polyglactin 910[15].

It is important to notice that recent Vicryl* Plus studies did not observe the effect of the suture on inflammatory biochemical parameters, especially on PCT levels, which are increased during inflammation and could be used, as CRP or leukocyte levels are, as an inflammation marker. In this current study the systemic inflammatory response was measured with wound complications, which resulted in the finding that triclosan coated polyglactin 910 activity and prevention of abdominal wound infections were related. Patients closed with the triclosan coated suture had a significantly shorter period of hospitalization, inflammation parameters were normalized in significantly shorter period, and wound dehiscence, postoperative incisional hernias, skin inflammation and wound secretion were significantly reduced. Considering these results, and previous in vitro and studies on animal models, it can be concluded that triclosan coated suture presents an opportunity to improve the postoperative wound healing process.

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UČINAK ANTIMIKROBNOG TRIKLOSANOM PRESVUČENOG ŠAVA, POLIGLAKTINA 910 (VICRYL* PLUS) NA ZATVARENJE RANA TRBUŠNE STJENKE NAKON KOLOREKTALNIH OPERACIJA

S A Ž E T A K

Ova studija uspoređuje učinak triklosanom presvušenog poliglaktina 910 (Vicryl* Plus) s učinkom poliglaktina 910 (Vicryl*) na cijeljenje trbušnog zida u kolorektalnih bolesnika. U studiju je uključeno 184 bolesnika. U 91 bolesnika trbušni zid je zašiven s Vicryl* Plus šavom, a 93 bolesnika s Vicryl* šavom. Promatrani su: demografska obilježja, biokemijski upalni parametri, izgled rane, vrijeme hospitalizacije, poslijeoperacijske komplikacije rane te učestalost poslijeoperacijskih hernija. U Vicryl* Plus grupi uočeno je kraće vrijeme boravka bolesnika u bolnici (13,2±1,3 dana; naprema 21,4±2,8) Također je u Vycril * Plus grupi uočena normalizacija upalnih parametara do normalnih vrijednosti unutar prvog poslijeoperacijskog tjedna, dok su te vrijednosti u Vycril grupi ostale povišene. U Vycril*Plus grupi 4 bolesnika je imalo infekciju rane, 7 bolesnika je imalo upalnu reakciju na kožne šave. Zapažena je jedna dehicenca rane. U Vicryl* grupi 12 bolesnika je imalo infekciju rane,14 bolesnika je imalo upalnu reakciju na kožne šave, a u 7 bolesnika je uočena dehiscence rane. Zatvaranje trbušnog zida Vicryl*Plus šavovima smanjuje učestalost poslijeoperacijskih komplikacija rane, skraćuje vrijeme boravka u bolnici te je povezana s brim padom upalnih laboratorijskih parameta do normalnih vrijednosti.