

**Received:** 07 December, 2020

**Accepted:** 07 January, 2021

**Published:** 08 January, 2021

**\*Corresponding author:** Valdemir José Alegre Salles, Assistant Doctor Professor, Department of Medicine, University of Taubaté, José Bonani, 199, CEP: 12031-260 Taubate, Sao Paulo, Brazil, Tel: +55-15-12-3681-3888; Fax: +55-15-12-3631-6061; E-mail: vjasia@gmail.com, valdemirsalles1962@gmail.com

**Keywords:** Sigmoidostomy; Sepsis complications; Bacteriology of skin; Infection

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## Research Article

# The sigmoidostomy as a determining factor in the change of cutaneous bacterial colonization

Valdemir José Alegre Salles<sup>1,2\*</sup>, Gustavo Simões de Araújo Alegre Salles<sup>3</sup>, Isabela Simões de Araújo Alegre Salles<sup>4</sup>, Julia Nicioli<sup>4</sup> and Juliana Almeida Lopes<sup>4,5</sup>

<sup>1</sup>Assistant Doctor Professor, Department of Medicine, University of Taubaté, Brazil

<sup>2</sup>General Surgeon at the Regional Hospital of Paraíba Valley, Taubaté, Brazil

<sup>3</sup>Medicine Student, University of Volta Redonda, UNIFOA, Brazil

<sup>4</sup>Resident of General Surgery at the University of Taubaté, Taubaté, Brazil

<sup>5</sup>Nutrition Student, University San Camilo, São Paulo, Brazil

## Abstract

**Aims:** Identifying the alterations occurred in the bacteriology of the dermic layer of the abdominal wall in patients who underwent a colostomy, through the qualitative and quantitative determination of the pericostomic colonization.

**Methods:** 19 cases have been carried out in the sigmoid colon. As for the age range, we have observed that the average age was 52 years. All patients have been colostomized for more than seven weeks.

**Results:** The aerobic bacterium more often found was the *Escherichia coli*. Among the anaerobic bacteria, the most frequent one was the *Bacteroides spp* (44.5%), in the benign colorectal condition, and the *Peptococcus spp* (43.7%) in the malign colorectal neoplastic condition. In the study of the association made between the presence of microorganism and the kind of medical condition, the *Enterobacter spp* bacterium had a higher incidence in the malign colorectal condition. The quantitative study showed variable rates in the number of colonies and microorganisms per gram of tissue, which is compatible with the qualitative analysis.

**Conclusions:** There is an alteration in the bacterial colonization in the dermic area in the pericostomic region, as a result from the colonization of this area by bacteria present in the intestinal matter.

## Introduction

The infection of the surgical area after the suture of the colostomy is attributed to the intestinal manipulation, exposing its content, added by the predominantly gram-negative bacterial colonization, present on the skin of these patients, developed from the colostomy procedure [1,2]. The incidence of stoma related complications ranged from 2.9% to 81.1%. Peristomal skin complications and parastomal hernia were the most common complications. End colostomy had the

highest incidence of morbidity, followed by loop colostomy and loop ileostomy [3].

The incidence of septic complications developed in the colostomy region usually varies from 0.5% to 25.0% [4,5], and the clinical wound characteristics for the diagnosis of infection include the edema, erythema, warmth and purulence [6].

Aim of this study was to characterize the bacterial colonization in the dermal tissue of the abdominal cutaneous tissue, in patients who underwent a sigmoidostomy.

## Methods

This study has included 19 patients with temporary sigmoidostomy, who had undergone reconstruction of the intestinal transit. The study has been approved by the Medical Ethics Commission and all patients have been informed on the procedure and agreed to participate, signing the Informed Agreement Term. The material analyzed has only been collected after written and clear agreement of patients.

Patients within the clinical stages I or II, adopted by the American Society of Anesthesiology were included, within the oncologic staging of TNM until stage II and who had been colostomized for more than six weeks. We did not admit patients with cutaneous changes, either located in the pericostomic region or any other systemic ones, who would be undergoing chemotherapy and/or radiotherapy, or had undergone one less than thirty days before. Neither did we admit the immune-depressive, diabetic, cachectic, and the ones being treated or having been treated with antibiotics and anti-inflammatories in the last thirty days and with infectious or inflammatory processes in other tissues.

Eleven individuals (58%), among the studied patients, were male and eight (42%) were female. As far as the age group is concerned, we observed that the average age was 52 years, with the minimum age of 16 and the maximum age of 84 years.

The colostomies were carried out in the sigmoid in the type terminal or loop. The illnesses whose surgical procedure involved a colostomy were: rectum trauma, rectum tumor, left colon tumor, sigmoid volvulus, acute diverticulitis of sigmoid, trauma of left colon and dehiscence of colorectal anastomosis. The interval of permanence time of the colostomy was the average time of 16.9 weeks. In the present study, ten patients underwent sigmoidostomy due to malignant neoplasia and nine patients had benign sigmoidorectal disease.

The anti-sepsis was carried out in the pericostomic region with saline solution at 0.9% and polyvinylpyrrolidone-iodine and sodium lauryl ether sulfate at 10%, for five minutes at least. By means of a punch of 0.3 cm of diameter, two biopsies of the cutaneous tissue were performed, next to the lower edge of the colostomy, at around 0.5 cm from the enterocutaneous anastomosis and around 1.0 cm equidistant from it.

The dermis samples were studied in two ways, regarding the presence of microorganisms: by means of aerobic and anaerobic culture (qualitative study), colonies counting and quantification of bacteria per gram of tissue (quantitative study).

## Results

In the culture exam in the derm of sigmoidostomy, the *Escherichia coli* (100%) has predominated among the aerobic bacteria in 100% of cases, followed by *Klebsiella* spp (31.6%), and among the anaerobic bacteria, the *Bacteroides* spp (31.6%) and the *Bacteroides fragilis* (31.6%), as it can be seen in Table 1.

When it comes to the bacterial species identified as being more frequently present in the pericostomic region, we

found that in patients with benign condition, the *Escherichia coli* (100.0%) and the *Klebsiella* spp (38.9%) were the aerobic bacteria more often found, whereas the *Bacteroides* spp (44.5%) and *Peptococcus* spp (33.3%) were the anaerobic ones; in the malign condition though, the aerobic bacteria *Escherichia coli* (81.2%) and *Enterobacter* spp (31.2%) and the anaerobic bacteria *Peptococcus* spp (43.7%) and the *Bacteroides fragilis* (37.5%) were more frequently present, according to the description seen on Table 2.

The quantitative analysis has been performed from the determination of the quantity of microorganisms present per gram of tissue. When analyzing the number of microorganisms per gram of tissue according to the benign colorectal condition, the main aerobic bacterium present was the *Escherichia coli*, with the average of  $1.6 \times 10^{10}$ , followed by *Klebsiella* spp with the average of  $7.7 \times 10^9$ . The anaerobic bacterium, *Bacteroides fragilis*, presented the average of  $1.2 \times 10^{10}$ , followed by the *Bacteroides* spp with  $9.9 \times 10^9$  and the *Peptococcus* spp with  $6.9 \times 10^9$ . As for the analysis of the number of microorganisms per gram of tissue, according to the malign colorectal neoplastic condition, the main aerobic bacterium was the *Escherichia*

**Table 1:** Determination of the number of cultures and their percentage according to the bacteria found in the peri-colostomy tissue.

Bacteria	Number of Culture	%
<i>Bacteroides fragilis</i>	06	31.6
<i>Bacteroides</i> spp	06	31.6
<i>Bifidobacterium</i> spp	01	5.2
<i>Enterobacter</i> spp	03	15.8
<i>Escherichia coli</i>	19	100.0
<i>Eubacterium</i> spp	02	10.5
<i>Fusobacterium</i> spp	01	5.2
<i>Klebsiella</i> spp	06	31.6
<i>Peptococcus</i> spp	06	26.3
<i>Pseudomonas aeruginosa</i>	01	5.2
<i>Staphylococcus epidermidis</i>	02	10.5

**Table 2:** Determination of the number of cultures and their percentage according to the underlying disease.

Bacteria	Condition			
	Benign disease		Malign disease	
	Number of culture	%	Number of culture	%
<i>Bacteroides fragilis</i>	4	22.2	6	37.5
<i>Bacteroides</i> spp	8	44.5	5	31.2
<i>Bifidobacterium</i> spp	1	5.5	0	---
<i>Enterobacter</i> spp	1	5.5	5	31.2
<i>Escherichia coli</i>	19	100	13	81.2
<i>Eubacterium</i> spp	2	11.1	0	---
<i>Fusobacterium</i> spp	2	11.1	0	---
<i>Klebsiella</i> spp	7	38.9	4	25
<i>Peptococcus</i> spp	6	33.3	7	43.7
<i>Pseudomonas aeruginosa</i>	1	5.5	0	----
<i>Staphylococcus epidermidis</i>	1	5.5	3	18.7



coli, which presented the average of  $2.7 \times 10^{10}$ , followed by the *Staphylococcus epidermidis* with  $2.6 \times 10^{10}$  and the *Klebsiella* spp with  $2.2 \times 10^{10}$ . The aerobic bacterium *Bacteroides* spp, presented the average of  $2.5 \times 10^{10}$ , followed by the *Peptococcus* spp with  $1.8 \times 10^{10}$  and the *Bacteroides fragilis* with the average of  $6.8 \times 10^9$ , according to what was described by Table 3.

In the process of intestinal transit reconstruction, no patient presented a complication considered to be greater in their postoperative evolution. There are some cases of partial dehiscence of the skin suture at the colostomy site without infection.

The control group was composed by twenty female patients, with chronic calculous cholecystitis, whose age group varied from 23 to 70 years, with the average age of 43.2 years, who had undergone elective laparoscopic colectomy, presenting exclusion factors which were exactly the same as the ones found in the studied group. A similar anti-sepsis was carried out in the control group. Two biopsies were performed, using a punch of 0.3 cm of diameter, in a strip of cutaneous tissue located in the right hypochondrium. Having finished that, the patient underwent laparoscopic colectomy. We did not observe the growth of any bacteria in the group of control-patients.

**Table 3:** Distribution of the average number of microorganisms per gram of tissue according to the underlying disease.

Bacteria	Benign Disease		Malign Disease	
	Number		Number	
	Culture	Average	Culture	Average
<i>Bacteroides fragilis</i>	4	$1.2 \times 10^{10}$	6	$6.8 \times 10^9$
<i>Bacteroides</i> spp	8	$9.9 \times 10^9$	5	$2.5 \times 10^{10}$
<i>Bifidobacterium</i> spp	1	$1.6 \times 10^9$	0	
<i>Enterobacter</i> spp	1	$1.8 \times 10^{10}$	5	$6.2 \times 10^9$
<i>Escherichia coli</i>	18	$1.6 \times 10^{10}$	13	$2.7 \times 10^{10}$
<i>Eubacterium</i> spp	2	$1.3 \times 10^9$	0	
<i>Fusobacterium</i> spp	2	$7.1 \times 10^9$	0	
<i>Klebsiella</i> spp	7	$7.7 \times 10^9$	4	$2.2 \times 10^{10}$
<i>Peptococcus</i> spp	6	$6.9 \times 10^9$	7	$1.8 \times 10^{10}$
<i>Pseudomonas aeruginosa</i>	1	$4.5 \times 10^9$	0	
<i>Staphylococcus epidermidis</i>	1	$3.8 \times 10^9$	3	$2.6 \times 10^{10}$

## Discussion

Several factors can be involved in the genesis of pericostomic bacterial colonization, which is made easier by the permanent contact of the local cutaneous area with the enteric content. Among the main factors, we highlight the colcutaneous fixing suture, including the mucosa, the intestinal segment with some kind of inflammatory disease, the dehiscence of the colcutaneous anastomosis, the presence of a foreign body, the contamination of a paracolic hematoma and the insufficient preparation of the colon [7,8]. The rate of stoma complications is not significantly different between patients who underwent nonemergent surgery and patients who underwent emergency surgery. Early stoma complication rates are higher in patients with malignant diseases. The site of the stoma is an independent risk factor for the development of stoma complication. Preoperative marking for stoma creation

should be considered to reduce the risk of stoma-related complications [9].

The modern devices of stool collection are placed as to remain adjusted to the enterocutaneous transition, with the intention of minimizing the complications developed in the pericostomic skin. Microbial organisms present in liquids in contact with the skin result in exposure both by preferential adsorption to the skin surface as well as through remaining in liquid retained in the skin. As a result, the quantity of pathogens retained on the skin after liquid contact is a function of both the volume of liquid on the skin and the concentration of the agent in the liquid. Exogenous factors such as temperature, humidity or the use of topical products have an impact on the hydration of the skin, and skin hydration could potentially influence water retention [10], fact that can be transposed to the fecal content that is in frequent contact with the cutaneous surface.

In this study, we chose an area next to the lower edge of the colostomy, in a stripe of cutaneous tissue around 0.5 cm away from the enterocutaneous transition, admitting that permanent contact of the enteric content with the cutaneous tissue would occur.

Loss of skin integrity may be related to chemical injury, mechanical destruction, infectious conditions, immunological reactions, disease-related conditions. Peristomal irritant dermatitis caused by skin contact with ostomy effluent is by far the most ordinary condition seen. Mechanical trauma, infection and aggravation of pre-existing skin diseases are also seen. Allergic contact dermatitis, which is often cited as the cause of peristomal skin problems, appears to be a rare condition with an estimated prevalence of only 0.6% [11].

The material would be collected before the administration of antibiotics and after the anti-sepsis of the skin, since the use of antibiotics can alter the bacteriologic exam, by inhibition or destruction of the infecting bacteria, the same way occurring when the topic anti-septic is used, since it works only in the bacterial flora of the cutaneous surface [12].

Among the bacteria, only 5% to 10% are coliform bacteria and the other are facultative bacteria, and the restricted anaerobic bacteria are present in 90% to 95% of times [13]. The more frequently aerobic bacteria found are: the *Escherichia coli*, the *Klebsiella*, the *Proteus*, the *Enterobacter* and the *Enterococcus*. Among the anaerobic ones, the *Bacteroides fragilis*, the *Peptostreptococcus* and the *Clostridium* [14]. The enteric bacteria *Escherichia coli*, *Bacteroides* spp, *Peptococcus* spp and *Klebsiella* spp were considered to be the most frequent found ones, due to the fact that they have been identified many times, throughout the proposed analysis. This does not mean that other bacteria have not developed in the samples of the collected material, as they occurred with a significantly less frequency than the first ones.

In the pericostomic dermal area of the sigmoidostomy, the *Escherichia coli* and the *Bacteroides fragilis*, were the enteric bacteria quantitatively identified with the highest number of microorganisms per gram of tissue.



When the presence of number of microorganisms per gram of tissue was analyzed according to the determining type of condition, we did not find any difference between the enteric bacteria in the colorectal benign and malign condition, represented by the *Escherichia coli*, *Bacteroides fragilis* and *Bacteroides spp.*

Therefore, considering the frequency of cultures and the number of microorganisms per gram of tissue, the most frequent bacteria found were the *Escherichia coli*, the *Bacteroides fragilis*, *Bacteroides spp* and the *Peptococcus spp*, as it had been expected, since they are the most frequent bacteria found in the cultures of fecal material; once it is admitted that they are the main source of bacteria for the colonization of the pericostomical dermis [14,15].

Other bacteria have been isolated, less frequently, such as the *Bifidobacterium spp*, the *Staphylococcus epidermidis*, the *Eubacterium spp*, the *Fusobacterium spp* and the *Pseudomonas aeruginosa*, whose percentage was not enough for a statistical analysis or even for an adequate arithmetical calculus.

- We have concluded among the aerobic bacteria, the *Escherichia coli*, was more frequently identified, as well as being the one which presents the greatest number of microorganisms per gram of tissue;
- among the anaerobic bacteria, the *Peptococcus spp* and the *Bacteroides spp* were more frequently identified, while the *Bacteroides fragilis*, presented the greatest number of microorganisms per gram of tissue;
- the *Enterobacter spp* occurred more frequently in the malign colorectal neoplastic condition in comparison with the colorectal benign condition and other bacteria.

The results of this study confirm that the enteric bacteria from the colostomy colonize the dermal layer of the abdominal wall in the sigmoidostomy region. Based on the identification of bacteria present in the pericostomical region, we can provide patients with appropriate treatment in cases of local infection, a fact that does not currently occur, in which antibiotic therapy is used empirically and often based on the experience of the stoma therapist or surgeon.

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