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Surgical site infection: An observer-blind, randomized trial comparing electrocautery and conventional scalpel

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ABSTRACT

Aim: To evaluate the incidence of surgical site infection (SSI) based on the type of scalpel used for incisions in the skin and in subcutaneous tissues.

Methods: Observer-blind, randomized equivalence clinical trial with two arms (electrocautery versus conventional scalpel) which evaluated 133 women undergoing elective abdominal gynecologic oncology surgery. A simple randomization stratified by body mass index (BMI: 30 kg/m^2) was carried out. Women were evaluated at 14 and 30 days following the operation. A multivariate analysis was performed in order to check whether the type of scalpel would be a risk factor for SSI.

Results: Group arms were balanced for all variables, excepted for surgical time, which was significantly higher in the electrocautery group (mean: 161.1 versus 203.5 min, $P = 0.029$). The rates of SSI were 7.4% and 9.7%, respectively, for the conventional scalpel and electrocautery groups ($P = 0.756$). The exploratory multivariate model identified body mass index ≥ 30 kg/m^2 (OR = 24.2, 95% CI: 2.8–212.1) and transverse surgical incision (OR = 8.1, 95% CI: 1.5–42.6) as independent risk factors for SSI. The type of scalpel used in surgery, when adjusted for these variables and the surgery time, was not a risk factor for SSI.

Conclusion: This study showed that the SSI rates for conventional scalpel and electrocautery were not significantly different. These results were consistent with others reported in the literature and would not allow a surgeon to justify scalpel choice based on SSI.

Trial number: NCT01410175 (Clinical Trials – NIH).

1. Introduction

Since World War I, medicine has evolved considerably, and the development of new instruments has produced better results in surgical treatments [1]. Surgical instruments have been modified to become increasingly more specific based on the types of procedures and their individual requirements. In 1926, William Bovie developed the first electrocautery, which offered the possibility of coagulation and tissue cutting using a source of energy [2,3]. Careful dissection and manipulation of tissues is essential to reduce tissue trauma during surgery. When used improperly or above the recommended charge, electrocautery can result in significant tissue devitalization.

Among all postoperative complications, surgical site infection (SSI) is the most common infection acquired during hospitalization [4,5]. Approximately two-thirds of these infections involve superficial incisions, and the remaining infections involve muscle tissue, organs or deep spaces. According to the Centers for Disease Control and Prevention (CDC), SSI can occur up to 30 days after the surgical procedure and up to one year when prostheses are implanted [6].

The aim of this study was to evaluate the incidence of SSI based on the type of scalpel used for incisions in the skin and in subcutaneous tissues (electrocautery versus conventional scalpels) in gynecologic oncology surgeries and evaluate whether the type of

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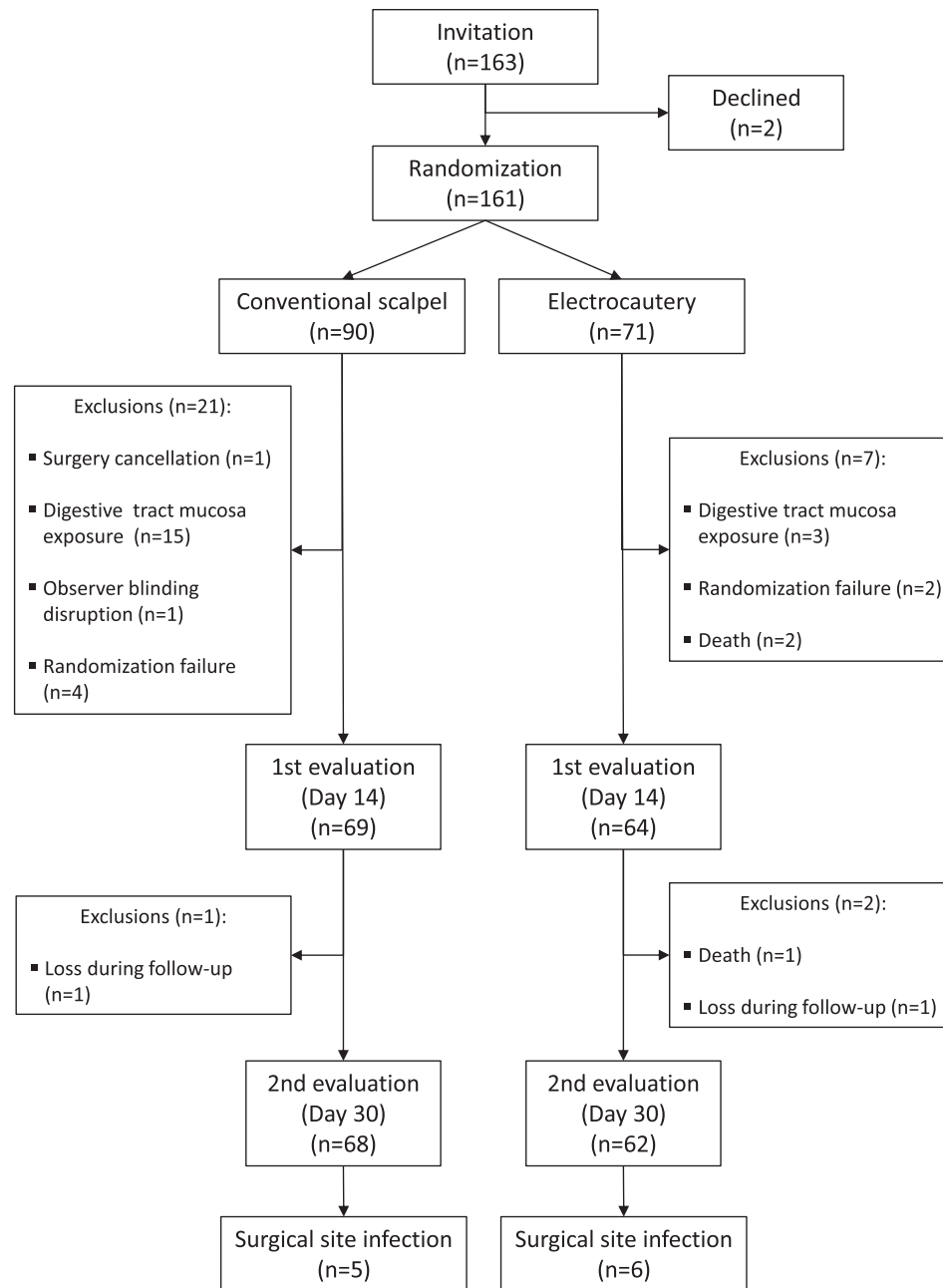E-mail address: mdfregnani@terra.com.br (J.H.T.G. Fregnani).

Fig. 1. Distribution of participants according to the study arm (Consort flowchart).

scalpel was a risk factor for infection. The hypothesis of this study was that the electrocautery and conventional scalpel would be equivalent in terms of SSI.

2. Methodology

This was an equivalence clinical trial in which only the observer was blinded. Patients were randomly allocated into two groups: conventional scalpel versus electrocautery. The study was conducted at Barretos Cancer Hospital [Hospital de Câncer de Barretos] from July 2010 to July 2012 on women undergoing elective abdominal gynecologic oncology surgery. The selection criteria included women older than 18 years of age who agreed to participate in the study and underwent elective abdominal gynecologic surgery via laparotomy for diagnosis and curative or palliative

cancer treatment. Women who underwent surgery that involved exposure of the digestive tract mucosa, ostomies, re-operations or emergency surgeries were excluded. In total, 163 patients were invited to participate in the study; 2 patients declined to participate, resulting in 161 randomized patients. Overall, 90 patients were selected for the conventional scalpel group, and 71 patients were selected for the electrocautery group. After randomization but before the first observation, 28 women were excluded for the following reasons: 1 woman had her surgery suspended in the operating room; the digestive tract mucosa was manipulated during surgery for 18 women (accidental rupture of the intestine mucosa, intestinal anastomosis or ostomy); the randomization process failed for 6 patients (including 2 patients who were younger than 18 years of age; randomization was duplicated for 1 patient; 3 patients were excluded because the surgeon did not use

Table 1
Distribution of cases according to sociodemographic, clinical and personal history variables and the type of scalpel used in surgery.

Variable	Categories/statistic	Conventional scalpel		Electrocautery		P value
		N	(%)	N	(%)	
Age	Years (mean)	56.2		54.9		0.585
Education	Illiterate	12	(17.6)	6	(9.7)	0.321
	≤8 years	31	(45.6)	35	(56.5)	
	>8 years	25	(36.8)	21	(33.9)	
Tobacco use	No	58	(85.3)	56	(90.3)	0.433
	Yes	10	(14.7)	6	(9.7)	
Body mass index	<30 kg/m^2	41	(60.3)	39	(62.9)	0.857
	≥30 kg/m^2	27	(39.7)	23	(37.1)	
History of diabetes	No	59	(86.8)	48	(77.4)	0.176
	Yes	9	(13.2)	14	(22.6)	
Preoperative blood glucose levels	<100 mg/dl	30	(46.2)	31	(50.8)	0.721
	≥100 mg/dl	35	(53.8)	30	(49.2)	
ASA surgical risk	1 or 2	60	(89.6)	54	(87.1)	0.786
	>2	7	(10.4)	8	(12.9)	
Prior adjuvant treatment	No	61	(89.7)	51	(82.3)	0.310
	Yes	7	(10.3)	11	(17.7)	
History of abdominal surgery	No	22	(32.4)	20	(32.3)	1.000
	Yes	46	(67.6)	42	(67.7)	

ASA: American Society of Anesthesiology.

the type of scalpel which had been randomized); the observer blinding was disrupted in 1 case; and 2 women died from co-morbidities in the period between surgery and the first outpatient follow-up visit. Additionally, 3 patients were excluded from the analysis between the first and second observation, 2 failed to return for follow-up, and 1 patient died due to causes unrelated to surgery. The final casuistic consisted of 130 women, with 68 in the conventional scalpel group and 62 in the electrocautery group (Fig. 1).

This study was previously approved by the Ethics Committee of Barretos Cancer Hospital [Hospital de Câncer de Barretos] and was registered in the Clinical Trials database under number NCT01410175. The patients who agreed to participate in the study signed an informed consent form. This study was supported by the Teaching and Research Institute of the Barretos Cancer Hospital.

2.1. Randomization

The Center for Research Support of the Institute of Education and Research at Barretos Cancer Hospital [Hospital de Câncer de Barretos] performed a simple and stratified randomization based on body mass index (30 kg/m^2). Randomization occurred at the surgical center using non-transparent envelopes prepared by the Center for the Researcher Support of the Barretos Cancer Hospital. Immediately before surgery, the attending surgeon randomly selected the type of scalpel to be used to open the skin and sub-cutaneous tissue.

2.2. Surgical incision and antibiotic prophylaxis

A conventional scalpel was used to open the epidermis, irrespective of the type of scalpel that was randomly selected to perform the surgery. After opening the epidermis, the subcutaneous tissue was opened to the aponeurosis with the randomized scalpel. Bleeding vessels in the subcutaneous tissue were allowed to be spot coagulated using electrocautery. The aponeurosis and peritoneum were incised using the electrocautery in "cut" mode in all cases. The surgical incision was made in the abdomen in a longitudinal or transverse manner, depending on the type of surgery, tumor size, and surgeon's decision. Lateral dissections of the subcutaneous tissue to better expose the aponeurosis were not performed. The electrocautery machine used in this study was a Valley Lab™ (Covidien, USA) model with a 30-W intensity.

Before the start of the study, a meeting was held with the four surgeons in the Gynecologic Oncology Department to explain the study and standardize the surgical techniques to be followed in the study.

All of the patients received intravenous cefazolin (2 g) 30 min prior to surgery and every 2 h during the procedure according to institutional protocols recommended by the Office of Hospital Infection Control.

2.3. Data collection

After randomization, the information regarding the socio-demographic, clinical and postoperative variables was obtained from medical records and interviews with the women. After discharge, the women received post-operative instructions from the nurses in the Gynecologic Oncology Department and scheduled follow-up outpatient visits for evaluation at 14 and 30 days following the operation. Wound assessments were performed by two nurses who specialized in standardized post-operative care but had no prior knowledge of the type of scalpel used in the surgery. The definition of an SSI was based on the criteria established by the CDC [7].

2.4. Sample size calculation

The sample size was based on an equivalence clinical trial power calculation. Taking into account an alpha error of 5%, a beta error of 20%, an expected SSI of 3–5% and an equivalence limit of 10%, 50 to 82 patients were required per group.

2.5. Statistical analysis

A database was structured and analyzed using the program Statistical Package for Social Sciences (SPSS) version 20.0 for Windows. Association analyses were performed using the chi-squared test or Fisher's exact test, depending on the expected values in the contingency tables. Student's t test was used to compare means between the types of scalpels. A logistic regression was performed for the identification of risk factors for wound complications. The modeling process occurred in two stages. The first stage aimed to

Table 2
Distribution of cases according to sociodemographic, clinical and personal history variables and the type of scalpel used in surgery.

Variable	Categories/Statistic	Conventional scalpel		Electrocautery		P value
		N	(%)	N	(%)	
Preoperative fast	Hours (mean)	10.9		11.4		0.305
Incision size	Centimeters (mean)	16.6		17.1		0.582
Surgery time	Minutes (mean)	169.1		203.5		0.029
Type of anesthesia	Spinal/epidural	18	(26.5)	16	(25.8)	1.000
	General	50	(73.5)	46	(74.2)	
Use of thermal blanket in surgery	No	2	(28.6)	5	(71.4)	0.257
	Yes	66	(53.7)	57	(46.3)	
Antibiotic prophylaxis	No	0	(0.0)	1	(100.0)	0.477
	Yes	68	(52.7)	61	(47.3)	
New dose of anti-biotic in surgery	No	47	(56.0)	37	(44.0)	0.261
	Yes	21	(45.7)	25	(54.3)	
Intraoperative transfusion	No	63	(52.9)	56	(47.1)	0.634
	Yes	5	(45.5)	6	(54.5)	
Potential contamination	Clean	25	(36.8)	20	(32.3)	0.712
	Potential	43	(63.2)	42	(67.7)	
Type of incision	Longitudinal	58	(85.3)	57	(91.9)	0.281
	Transverse	10	(14.7)	5	(8.1)	
Surgical incision on previous incision	No	21	(45.7)	20	(47.6)	1.000
	Yes	25	(54.3)	22	(52.4)	
Hysterectomy	No	24	(35.3)	22	(35.5)	1.000
	Yes	44	(64.7)	40	(64.5)	
Adnexectomy	No	8	(11.8)	10	(16.1)	0.612
	Yes	60	(88.2)	52	(83.9)	
Lymphadenectomy (pelvic/aortic)	No	54	(79.4)	46	(74.2)	0.535
	Yes	14	(20.6)	16	(25.8)	
Omentectomy	No	53	(54.6)	44	(45.4)	0.362
	Yes	15	(45.5)	18	(54.5)	
Immediate postoperative stay in the ICU	No	62	(53.4)	54	(46.6)	0.454
	Yes	6	(42.9)	8	(57.1)	

identify the risk factors in an exploratory model by selecting variables with descriptive levels less than 0.10. Therefore, the selected variables were placed sequentially one by one into the model, starting with higher P values and moving to lower P values. Only those variables with a P value equal to or less than 0.05 were kept in the model. In the second stage (non-exploratory), the type of scalpel was manually adjusted for the independent risk factors found in the preliminary exploratory model. In this step, an adjustment for the variable surgical time was also added, whose average value was significantly higher in the electrocautery group (see description of the patient sample in the results section). The significance level for all of the statistical tests was set at 5%.

3. Results

Tables 1 and 2 show the distribution of cases according to the type of scalpel and the different variables in the study. Among the variables analyzed, the only one that showed a difference according

Table 3
Distribution of cases according to sociodemographic, clinical and personal history characteristics and the presence of surgical site infection.

Variable	Categories/Statistic	Surgical site infection				P value
		No		Yes		
		N	(%)	N	(%)	
Age	Years (mean)	55.4		56.8		0.747
Education	Illiterate	18	(100.0)	0	(0.0)	0.279
	≤8 years	58	(87.9)	8	(12.1)	
	>8 years	43	(93.5)	3	(6.5)	
Tobacco use	No	103	(90.4)	11	(9.6)	0.358
	Yes	16	(100.0)	0	(0.0)	
Body mass index	<30 kg/m^2	79	(98.8)	1	(1.2)	<0.001
	≥30 kg/m^2	40	(80.0)	10	(20.0)	
History of diabetes	No	100	(93.5)	7	(6.5)	0.105
	Yes	19	(82.6)	4	(17.4)	
Preoperative blood glucose levels	<100 mg/dl	58	(95.1)	3	(4.9)	0.208
	≥100 mg/dl	57	(87.7)	8	(12.3)	
ASA surgical risk level	1 or 2	105	(92.1)	9	(7.9)	0.616
	>2	13	(86.7)	2	(13.3)	
Prior adjuvant treatment	No	102	(91.1)	10	(8.9)	1.000
	Yes	17	(94.4)	1	(5.6)	
History of abdominal surgery	No	39	(92.9)	3	(7.1)	1.000
	Yes	80	(90.9)	8	(9.1)	

ASA: American Society of Anesthesiology.

Table 4
Distribution of cases according to sociodemographic, clinical and personal history characteristics and the presence of surgical site infection.

Variable	Categories/Statistic	Surgical site infection				P value
		No		Yes		
		N	(%)	N	(%)	
Preoperative fast	Hours (mean)	11.1		11.9		0.339
Incision size	Centimeters (mean)	16.6		20.0		0.036
Surgery time	Minutes (mean)	182.2		220.9		0.170
Type of anesthesia	Spinal/epidural	33	(97.1)	1	(2.9)	0.286
	General	86	(89.6)	10	(10.4)	
Type of scalpel	Conventional	63	(92.6)	5	(7.4)	0.756
	Electrocautery	56	(90.3)	6	(9.7)	
Use of thermal blanket in surgery	No	7	(100.0)	0	(0.0)	1.000
	Yes	112	(91.1)	11	(8.9)	
Antibiotic prophylaxis	No	1	(100.0)	0	(0.0)	1.000
	Yes	118	(91.5)	11	(8.5)	
New dose of anti-biotic in surgery	No	75	(89.3)	9	(10.7)	0.326
	Yes	44	(95.7)	2	(4.3)	
Intraoperative transfusion	No	109	(91.6)	10	(8.4)	1.000
	Yes	10	(90.9)	1	(9.1)	
Potential contamination	Clean	43	(95.6)	2	(4.4)	0.328
	Potential	76	(89.4)	9	(10.6)	
Type of incision	Longitudinal	108	(93.9)	7	(6.1)	0.024
	Transversal	11	(73.3)	4	(26.7)	
Surgical incision on	No	37	(90.2)	4	(9.8)	1.000
Previous incision	Yes	43	(91.5)	4	(8.5)	
Hysterectomy	No	43	(93.5)	3	(6.5)	0.746
	Yes	76	(90.5)	8	(9.5)	
Adnexectomy	No	17	(94.4)	1	(5.6)	1.000
	Yes	102	(91.1)	10	(8.9)	
Lymphadenectomy	No	92	(92.0)	8	(8.0)	0.715
(pelvic/aortic)	Yes	27	(90.0)	3	(10.0)	
Omentectomy	No	87	(89.7)	10	(10.3)	0.288
	Yes	32	(97.0)	1	(3.0)	
Immediate	No	106	(91.4)	10	(8.6)	1.000
postoperative stay in ICU	Yes	13	(92.9)	1	(7.1)	

to the type of scalpel was the surgical time, which was significantly higher in the electrocautery group (mean: 161.1 versus 203.5 min, $P = 0.029$).

The overall rate of surgical wound complications (surgical site infection, discharge, dehiscence and epidermolysis) was 24.6% ($n = 32$) within 30 days post-operation. The incidence rates according to the type of complication were as follows: SSI (8.5%, $n = 11$), surgical wound secretions (23.1%, $n = 30$), dehiscence (10.8%; $n = 14$) and epidermolysis (0.8%, $n = 1$).

For the cases in which SSI was diagnosed, material from the wound was taken from 6 cases for culturing and yielded the following results: *Staphylococcus aureus* ($n = 3$), *Staphylococcus epidermidis* ($n = 1$), *Morganella morganii* ($n = 1$) and *Escherichia coli* ($n = 1$). In the other cases, the diagnosis was made clinically based on the criteria described previously. The rates of SSI were 7.4% and 9.7%, respectively, for the conventional scalpel group and electrocautery group ($P = 0.756$).

Tables 3 and 4 show the bivariate analysis of risk factors for SSI. The following variables analyzed showed a positive relationship with infection up to 30 days post-operation: body mass index (BMI) and the orientation of the surgical incision. Patients with a BMI ≥ 30 kg/m^2 had a significantly higher rate of infection than patients with a BMI less than 30 kg/m^2 (20% versus 1.2%, $P < 0.001$). The rate of infection in the transverse incisions was substantially greater than the rate for longitudinal incisions (26.7% versus 6.1%, $P = 0.024$). The type of scalpel used in surgery was not associated with SSI in the bivariate analysis ($P = 0.634$).

Table 5 provides a multivariate analysis that examines whether the type of scalpel was a possible variable associated with SSIs. The

preliminary exploratory multivariate model identified BMI ≥ 30 kg/m^2 (OR = 24.2, 95% CI: 2.8–212.1) and transverse surgical incision (OR = 8.1, 95% CI: 1.5–42.6) as independent risk factors for infection. The type of scalpel used in surgery, when adjusted for these variables and the surgery time, was not a risk factor for SSIs.

4. Discussion

Most studies that have compared different types of scalpels have used non-cancer patients. When this trial was designed, surgeons

Table 5
Multi-stage analysis to evaluate the type of scalpel as a possible risk factor for surgical site.

Variable	Category	N	OR	95% CI (OR)	P value
First stage of modeling (exploratory model)					
Body mass index	<30 kg/m^2	80	1.0	Reference	
	≥ 30 kg/m^2	50	24.2	2.8–212.1	0.004
Type of abdominal	Longitudinal	115	1.0	Reference	
Incision	Transverse	15	8.1	1.5–42.6	0.013
Second stage of modeling (non-exploratory model)					
Type of scalpel	Conventional	68	1.0	Reference	
	Electrocautery	62	1.5	0.3–6.9	0.605
Body mass index	<30 kg/m^2	80	1.0	Reference	
	≥ 30 kg/m^2	50	27.2	3.0–246.2	0.003
Type of abdominal	Longitudinal	115	1.0	Reference	
incision	Transversal	15	8.2	1.4–47.4	0.019
Surgery time	(Continuous variable)	130	1.007	0.997–1.016	0.187

OR: odds ratio.
95% CI: confidence interval (95%).

Table 6
Studies using conventional scalpel and electrocautery.

Author	Year	Country	Study type	Surgery	Conventional (n)	Electrocautery (n)	Outcome	Results
Johnson and Serpell [7]	1990	United Kingdom	Randomized controlled	Laparotomy	130	110	Incision time Wound infection	Similar between groups
Hemsell et al. [8]	1993	United States	Randomized clinical trail	Hysterectomy	191	189	Post-op. complications	No significant differences
Telfer et al. [9]	1993	United Kingdom	Randomized	Laparotomy Colorectal cancer	50	51	Incision time Post-op. pain Blood loss	Electrocautery: Less blood loss
Groot et al. [10]	1994	Canada	Blind, randomized clinical trail	Abdominal and thoracic surgery	250	242	Wound infection	Similar between groups
Franchi et al. [11]	2001	Italy	Transverse	Gynecologic oncology	531	433	Early and late post-op. Complications	Similar between groups
Kearns et al. [12]	2001	Ireland	Randomized clinical trial	Laparotomy	50	50	Incision time Post-op. pain Blood loss Complications	Electrocautery: Less blood loss Less pain 1 and 2 days post-op. No differences in complications
Shamim [13]	2009	Pakistan	Blind, randomized clinical trial	General surgery	184	185	Incision time Blood loss Post-op. pain Complications	Electrocautery: Shorter incision time Less blood loss Less post-op. pain No differences in complications
Eren et al. [14]	2010	Istanbul	Randomized	Laparotomy Gastrointestinal cancer	97	121	Wound infection Incisional hernia	No significant differences

at the Gynecology Department did not perform laparoscopic procedures, or only performed them seldom. The start of this clinical trial coincided with the introduction of laparoscopy in the group, which significantly reduced the number of cases eligible for this study. This outcome can be seen clearly in Fig. 1, where laparoscopic surgery was recommended for approximately half of the procedures. Another difficulty encountered in the study was the exclusion of patients following randomization. Most of these exclusions occurred during surgery, resulting from the manipulation of the digestive tract, which is a known risk factor for SSIs. In other cases, there was failure to follow-up with patients, or the patients died before the second follow-up evaluation. In a minority of cases, exclusion occurred due to a methodological error: in 1 case the observer accidentally noted the allocation group, and in 6 cases, there was a failure in the randomization process.

The main objective of this study was to evaluate SSI rates based on the type of scalpel used in the procedure. The incidence of SSI was similar between conventional scalpel (7.4%) and electrocautery (9.4%), although those rates were slightly higher than expected to be. The NTT (number needed to treat) to prevent one SSI event using a conventional scalpel would be relatively high (NTT = 100, annually), which suggests that there is no practical advantage to using a conventional scalpel compared with electrocautery.

Our results are consistent with other studies [7–14] (Table 6). A recent meta-analysis performed by Ahmad et al., which included 3122 patients, compared the use of conventional scalpels and electrocautery for skin incisions in abdominal surgery and showed that there was no statistically significant difference in the SSI rates between the two groups. However, the study demonstrated that postoperative pain in the first 24 h, the time to perform the surgical incision and blood loss were lower in the electrocautery group [15].

Although the SSI rates appear very high in both arms, it should be noted that in clinical trials such as this one, surveillance for complications is much higher than following routine surgery. Knaust et al. evaluated the incidence of SSI following patient discharge from a university hospital in Germany using a questionnaire or telephone interview to conduct surveillance. Surveillance performed only during hospitalization found an SSI rate of

1.3%, whereas active surveillance following discharge showed a rate of 7.5% [16]. Martins et al. also conducted post-discharge surveillance to identify SSIs in 640 children and adolescents in a university hospital using an active search, chart review, notification by physicians and/or family and a telephone interview. Using this method, the authors reported that the overall rate of SSIs was 11.9% [17]. In another study, Charoenkwan et al. reported an SSI rate of 7.7% for potentially contaminated surgeries [18].

Interestingly, BMI was a risk factor not only for SSI but also for other complications such as secretion and dehiscence (data not shown). In the multivariate analysis, even after diabetes had been added to the model, the variable BMI was still significance, suggesting that the amount of adipose tissue was more important in the development of postoperative complications than a patient's diabetes status. Merkow et al. conducted a prospective study with obese patients undergoing colectomy for cancer and showed that morbid obesity (BMI $\geq$ 35 kg/m^2) represented a significant risk factor for wound complications. Compared with patients with a normal BMI, morbidly obese patients had a 2.6 greater chance of developing an SSI [19]. The explanation for this observation does not appear to be simple. It is possible that the greater exposure of adipose tissue and deep tissue to the external environment increases the chance of complications. Another possible explanation for the association between BMI and wound complications is the increased possibility of bleeding and/or exudation of subcutaneous tissues. These data suggest that as this exposed area increases, the possibility of SSI also increases.

In addition to BMI, the multivariate analysis also identified the type of incision as a risk factor for SSI. Patients with a transverse incision had a higher risk of infection compared with patients with a vertical incision. In the case of gynecological surgeries, transverse incisions are made in the lower part of the abdomen, near the pubis, which naturally forms a skin fold. This, in turn, can accumulate moisture, secretions and dirt, which could increase the chances of an SSI. Curiously, in the study by Thornburg et al., the authors reached a result that conflicts with the data presented here, reporting that there was a higher likelihood of complications in vertical incisions (infection and dehiscence) [20]. Although it is not easy to explain this difference, the patient sample reported by

Thornburg et al. should be considered because the authors only included women undergoing cesarean delivery, making their sample dissimilar to our patient sample. In general, vertical incisions for caesarean sections are used in situations with greater obstetric complexity, which could explain the higher rate of complications in this group of women. A meta-analysis reported by Grantcharov et al. compared the post-operative complications of patients who received vertical or transverse abdominal incisions and found that transverse incisions reduced the risks of abdominal dehiscence, pulmonary complications and hernias compared with vertical incisions, although there was no significant difference in the infection rate based on the type of incision. However, that study did not compare the BMIs of the patients to the type of surgical incision with respect to post-operative complications [21]. Hemsell et al. evaluated 380 women who underwent a hysterectomy and reported no difference in the rate of surgical wound complications based on the type of incision (vertical or transverse) [8].

In summary, this study showed that the SSI rates for conventional scalpels and electrocautery were not significantly different. Although this topic appears to be less important in the era of minimally invasive surgery such as laparoscopy and robotic surgery, the topic is still current given that not all patients are candidates for minimally invasive surgery. The results reported here were consistent with the results reported in the literature and would not allow a surgeon to justify scalpel choice based on SSI occurrence.

Ethical approval

This study was approved by the Ethics Committee of the Barretos Cancer Hospital in May 14, 2010 (Judgment's reference number: 325/2010).

Author contribution

Regiane Ladislau Rongetti: Principal investigator, study coordination, conception and design of the study, critical analysis of the results, data acquisition, database management, manuscript writing.

Paulo de Tarso Oliveira e Castro: conception and design of the study, critical analysis of the results.

Renê Aloisio da Costa Vieira: conception and design of the study, critical analysis of the results.

Sérgio Vicente Serrano: conception and design of the study, critical analysis of the results.

Mariana Fabro Mengatto: Data acquisition, critical analysis of the results database.

José Humberto Tavares Guerreiro Fregnani: conception and design of the study, data analysis, critical analysis of the results, database management, manuscript writing.

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Conflicts of interest

The authors do not have any conflict of interest.

Acknowledgments

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