Use of prophylactic closed-incision negative-pressure therapy (CINPT) is associated with reduced surgical-site infections in patients undergoing open abdominal surgeries during the Covid-19 pandemic

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Background

Surgical-site infections (SSIs) are found to occur after about 2–5% of all surgeries. SSIs have many drawbacks such as the need for readmission, revision operations, prolonged duration of hospital stay, increased financial burden on patients and increased risk of worsening outcome in cancer patients. Closed-incision negative-pressure therapy (CINPT) was studied as a method of preventing infections in wounds occurring after closed surgical incisions particularly during the covid-19 pandemic. There are many studies showed promising results of this procedure. Therefore, in this prospective clinical randomized study, we aimed to evaluate the benefit of performing prophylactic CINPT in controlling SSIs in open colorectal surgeries, hepatobiliary surgeries and gynecological cancer surgeries involving laparotomies, in comparison with the standard dressings.

Patients and method

We included 120 patients of SSIs with open colorectal surgeries, hepatobiliary surgeries and gynecological cancer surgeries involving laparotomies in the period between 2015 and 2020. We divided the patients randomly into two groups: the first group is the study group, which included 30 patients managed by CINPT, and the second group is the control group, which included 90 patients managed by standard non-CINPT management. We compared patients who underwent CINPT with the control group of high-risk patients undergoing routine management non- CINPT procedures.

Results

The median rate of occurrence of general adverse wound outcomes was 32.5% for all the included patients: 20% in the CINPT group and 36.7% in the control group (P =0.049). The median rate of occurrence of SSIs was 17.5% for all the included patients: 7% in the CINPT group and 15% in the control group (P=0.001). Time to diagnose SSIs in the CINPT group was longer than that in the control group (19 vs 13 days; P=0.03). The increased duration of operation and the presence of preoperative or postoperative stoma were associated with increased incidence of occurrence of SSI, while CINPT was associated with decreased incidence of occurrence of SSIs ($P<0.001$).

Conclusion

We observed a marked reduction in the rates of SSIs in closed laparotomy wounds in colorectal, hepato-pancreato-biliary and in gynecological oncology surgeries managed with prophylactic CINPT particularly during the Covid-19 pandemic.

Keywords:
Closed-incision negative-pressure therapy (CINPT), open abdominal surgeries, surgical-site infections

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Introduction

Surgical-site infections (SSIs) are considered a common complication of surgical procedures that occur after about 2–5% of all surgeries [1]. SSIs have many drawbacks such as the need for readmission, revision operations, prolonged duration of hospital stay, increased financial burden on patients and increased risk for worsening outcome in cancer patients [2–4]. The incidences of SSIs differ according to the type of operation; these occur in about 30% of gynecologic cancer patients who undergo laparotomies [5,6], about

8.5–31.5% of patients who undergo hepatobiliary surgeries [7] and about 4% of patients who undergo colorectal surgeries [4].

According to the classification of the Center of Disease Control, SSIs were divided into three classes: superficial SSIs that included skin and subcutaneous tissue infections, deep incisional SSIs (iSSIs) in case of effects on deep structures such as fascia and muscles and organ space SSIs in the case of intra-abdominal infections as in the case of anastomotic leakage [8].

Closed-incision negative-pressure therapy (CINPT) was studied as a method of preventing infections in wounds that occurred after closed surgical incisions [9]. In this procedure, the wound is immediately sealed after closing the skin under sterile conditions using a certain bandage of foam foil, followed by placement of a negative pressure device. Many studies have reported promising results with the use of this procedure [10,11].

However, as most of these studies had relatively small sample sizes, the results of this procedure are not conclusive or established as yet.

Therefore, in this prospective clinical randomized study, we aimed to evaluate the benefits of performing prophylactic CINPT in controlling iSSIs in open colorectal surgeries, hepatobiliary surgeries and gynecological cancer surgeries involving laparotomies, in comparison to the standard non-CINPT dressings particularly during the Covid-19 pandemic.

Patients and method

We included all patients deemed to at high risk of developing SSIs who underwent open colorectal surgeries, hepatobiliary surgeries and gynecological cancer surgeries involving laparotomies in the General Surgery Department and in the Gynecology and Obstetrics Department, Faculty of Medicine, Zagazig University Hospitals, in the period between March 2015 and March 2020. Anesthesia was administered for all patients in the Anesthesia and Intensive care Department, Faculty of Medicine, Zagazig University Hospitals.

Patients were considered to be at high risk for SSIs in the following cases: presence of preoperative or postoperative stoma, morbid obesity, diabetes mellitus, preoperative use of steroid or immunosuppressant use and presence of contaminated or dirty wounds.

Exclusion criteria

The following patients were excluded: (1) those with social or family conditions that interfere with the study; (2) patients who did not achieve primary wound closure; and (3) patients with a planned second-look laparotomy within 30 days of the primary procedure.

Assessment of risks of SSIs was performed using the SSI risk score with a combination of both preoperative and operative parameters [1].

Approval for performing the study was obtained from the Institutional Review Board of the Faculty of Medicine, Zagazig University.

Choice of management

On the basis of the inclusion criteria and selection of 120 high-risk patients undergoing open abdominal surgeries, whether colorectal surgeries (40 patients), gynecological cancer surgeries (40 patients) and/or hepatobiliary surgeries (40 patients), we divided the patients randomly into two groups: the first group is the study group, which included 30 patients managed by CINPT, and the second group is the control group, which included 90 patients managed by standard non-CINPT management. Both groups had similar risks of developing SSIs. Management of the study group including prophylactic CINPT using a specific device (Prevena Incision Management System, KCI, an Acelity company, San Antonio, Texas, USA) was performed according to the opinion of the operating surgeons. In the operating room, we applied a vacuum device over the intact incision under sterile conditions and then left it in place for about 5–7 days. It was removed later in the hospital or in the outpatient clinic, as deemed suitable. The vacuum device provides suction at a pressure of 125 mmHg.

We did not remove CINPT dressings routinely for inspecting the incision, except when clinically indicated.

We applied standard dressings after wound closure, which included either high-viscosity tissue adhesive skin glue or adhesive bandage dressing that is routinely removed on the second postoperative day.

We compared patients who underwent CINPT in the control group of high-risk patients undergoing routine management non-CINPT procedures. All patients received a similar perioperative workup. Oral antibiotics and mechanical bowel preparation were routinely used for all colorectal surgeries. Intravenous antibiotics were administered to all patients within an hour of the surgical incision and were stopped within 24 h of surgery.

Assessment of outcome parameters

We reviewed and collected patient demographics, oncologic and surgical data including operative time, class of the wound, details of the performed procedure, dose and duration of antibiotic prophylaxis and perioperative blood transfusion.

Our primary outcomes included measurement and evaluation of 30-day superficial SSIs, deep SSIs or dehiscence; we excluded organ space SSIs as they were not affected by CINPT. Our secondary outcomes included measurement of length of hospital stay, occurrence of unplanned readmissions and organ space SSI.

Management of the control group

The wound is bandaged under sterile conditions in the operating room using a gauze dressing of appropriate size and configuration. We performed aseptic dressing changes as part of the routine clinical ward whenever required. In case of occurrence of iSSIs in the dressing changes, we considered that the primary outcome was reached and we can treat the incision independent of the protocol according to standard management.

As a rule, the more frequent the dressing changes, the higher the chance of discovering more SSIs in the control group.

We compared both the study group, which was managed by CINPT, and the control group in terms of the perioperative and postoperative characteristics and outcomes.

We assessed the occurrence of adverse wound outcomes such as superficial iSSI, deep iSSI, deep space/organ infection, wound dehiscence, seroma and hematoma and adverse surgical outcomes such as re-operation, readmission, intensive care unit admission, urinary tract infection, pneumonia and anastomotic leak.

Written informed consents were obtained from all included patients. Approval was acquired from local ethical committee of Faculty of Medicine Zagazig University.

Statistical analysis

We carried out all statistical analyses using IBM SPSS Statistics version 24.0.0.1 for Macintosh (IBM Corp., Armonk, New York, USA).

We used the χ^2 test or Fisher's exact test to compare categorical variables. We used a two-tailed independent samples t-test or the Wilcoxon rank-sum test for comparison of continuous variables. We used stratification according to the van Walraven SSI risk scores to identify 1 : 1 matched cohorts of patients receiving CINPT and those not receiving CINPT.

We performed multivariable logistic regression to determine predictors of SSIs. We determined statistical significance using a P value of less than 0.05.

Results

Patient cohort

We included 40 patients who underwent open colorectal surgery, 40 patients with HBS and 40 patients with gynecological cancer. The three groups were managed by the two procedures compared: CINPT (10 patients in each group) or standard non-CINPT (20 patients in each group).

We found no statistically significant differences between the patients in terms of baseline and demographic data.

Detailed baseline and demographic data of all included patients and patients in the three included groups are detailed in Tables 1 and 2.

We found no significant differences between patients in terms of preoperative findings.

The median rate of occurrence of general adverse wound outcomes such as superficial iSSI, deep iSSI, deep space/organ infection, wound dehiscence, seroma and hematoma was 32.5% for all the included patients: 20% in the CINPT group and 36.7% for the control group (P=0.049).

The median rate of occurrence of SSIs was 17.5% for all the included patients: 7% in CINPT and 15% for the control group (P=0.001).

The median rate of organ space SSI, adverse wound outcomes and adverse surgical outcomes in the non-CINPT group was higher than that in the CINPT group, but the results were statistically insignificant.

Time to diagnose SSIs in the CINPT group was longer than that in the control group (19 vs 13 days; P=0.03).

The increased duration of operation and the presence of preoperative or postoperative stoma were associated with increased incidence of occurrence of SSIs, while CINPT was associated with decreased incidence of occurrence of SSIs (P<0.001).

Table 1 Baseline findings and demographic data of all the included patients (total of 120 patients) managed by standard non-CINPT or CINPT

	Non-CINPT, *N*=90	CINPT, *N*=30		*P* value
Age	38 (15–55)	43 (34–55)	40 (15–55)	0.004
Sex				
F	58 (64.4%)	20 (66.7%)	78 (65.0%)	0.825
M	32 (35.6%)	10 (33.3%)	42 (35.0%)	
BMI	43 (16–54)	37 (16–54)	42 (16–54)	0.066
Steroid use				
Absent	62 (68.9%)	22 (73.3%)	84 (70.0%)	0.645
Present	28 (31.1%)	8 (26.7%)	36 (30.0%)	
DM				
Absent	72 (80.0%)	24 (80.0%)	96 (80.0%)	1.000
Present	18 (20.0%)	6 (20.0%)	24 (20.0%)	
COPD				
Absent	68 (75.6%)	21 (70.0%)	89 (74.2%)	0.661
Present	22 (24.4%)	11 (30.0%)	31 (25.0%)	
Smoking				
Absent	74 (82.2%)	24 (80.0%)	98 (81.7%)	0.785
Present	16 (17.8%)	6 (20.0%)	22 (18.3%)	
Admitted to hospital before surgery				
Absent	81 (90.0%)	24 (80.0%)	105 (87.5%)	0.151
Present	9 (10.0%)	6 (20.0%)	15 (12.5%)	
ASA class				
1	6 (6.7%)	0 (0.0%)	6 (5.0%)	0.101
2	36 (40.0%)	12 (40.0%)	48 (40.0%)	
3	42 (46.7%)	12 (40.0%)	54 (45.0%)	
4	6 (6.7%)	6 (20.0%)	12 (10.0%)	

ASA, American Society of Anesthesiologists; BMI, body mass index; CINPT, closed-incision negative-pressure therapy; COPD, chronic obstructive pulmonary disorder; DM, diabetes mellitus; F, female; M, male.

Secondary outcomes

Insignificant differences were found between both groups in terms of the mortality rate, duration of postoperative stay at hospital and other complications in the surgical wound.

The incidence of readmissions was markedly reduced in CINPT patients in comparison with the control group (8 vs 16%; *P*=0.01).

Discussion

In the present report, we found that performing CINPT in high-risk patients undergoing open surgeries for the treatment of HBD, gynecological oncologic surgery and colorectal surgery was associated with reduced incidences of occurrence of postoperative SSIs in comparison with the control groups of patients who underwent routine management of surgical wounds. We observed a reduction in the SSI risk score in patients managed by CINPT, which was about 6.5%, in comparison with the control group, which was about 15%. Moreover, we showed that the occurrence of SSIs in the group of patients managed by CINPT was discovered about a week later than patients in the control group, which emphasizes the significance of performing postoperative wound surveillance in these patients; this was comparable with the results of previous studies in open colorectal surgery, HBS and gynecologic oncology patients [1,2,6,12].

These findings might be related to the temporary and incomplete closure of the dead space in addition to fluid evacuation during CINPT.

To date, there is no consensus on the use of CINPT routinely for all open surgical wounds, not just emergency cases.

Hyldig *et al.* [11] carried out a meta-analysis of seven clinical trials that compared CINPT with routine wound management and included general surgery, cardiac, orthopedics and plastic surgery cases. They found that CINPT reduced the incidence of SSIs from 8.9 to 4.7%. Similarly, Scalise *et al.* [10] reported a reduction in the rate of SSIs with CINPT in most reviewed studies. In addition, Pellino *et al.* [13] and Bonds *et al.* [14] evaluated reports that studied only

Table 2 Baseline findings and demographic data of patients who underwent open abdominal surgery for the management of colorectal cancer (CRC), hepatobiliary surgery (HPS) or gynecologic cancer managed by standard non-CINPT or CINPT

	Surgery								
	CRC, *N*=40		*P*	HBS, *N*=40		*P*	Gynecologic cancer, *N*=40		*P*
	Non-CINPT, *N*=30	CINPT, *N*=10		Non-CINPT, *N*=30	CINPT, *N*=10		Non-CINPT, *N*=30	CINPT, *N*=10	
Age	38 (15–55)	42 (34–55)	0.079	38 (15–55)	42 (34–55)	0.079	40 (23–55)	45 (34–55)	0.096
Sex									
F	14 (46.7%)	5 (50.0%)	0.855	14 (46.7%)	5 (50.0%)	0.855			
M	16 (53.3%)	5 (50.0%)		16 (53.3%)	5 (50.0%)				
BMI	41 (16–54)	35 (16–54)	0.876	41 (16–54)	29 (16–46)	0.222	45 (20–54)	40 (16–45)	0.022
Steroid use									
Absent	22 (73.3%)	8 (80.0%)	0.673	20 (66.7%)	7 (70.0%)	0.845	20 (66.7%)	7 (70.0%)	0.845
Present	8 (26.7%)	2 (20.0%)		10 (33.3%)	3 (30.0%)		10 (33.3%)	3 (30.0%)	
DM									
Absent	24 (80.0%)	8 (80.0%)	1	24 (80.0%)	8 (80.0%)	1	24 (80.0%)	8 (80.0%)	1
Present	6 (20.0%)	2 (20.0%)		6 (20.0%)	2 (20.0%)		6 (20.0%)	2 (20.0%)	
COPD									
absent	23 (76.7%)	7 (70.0%)	0.673	22 (73.3%)	7 (70.0%)	0.787	23 (76.7%)	7 (70.0%)	0.673
Present	7 (23.3%)	3 (30.0%)		7 (23.3%)	3 (30.0%)		7 (23.3%)	3 (30.0%)	
Smoking									
Absent	22 (73.3%)	7 (70.0%)	0.838	22 (73.3%)	7 (70.0%)	0.838	30 (100.0%)	10 (100.0%)	
Present	8 (26.7%)	3 (30.0%)		8 (26.7%)	3 (30.0%)		0 (0.0%)	0 (0.0%)	
Admitted to hospital before surgery									
Absent	27 (90.0%)	8 (80.0%)	0.408	27 (90.0%)	8 (80.0%)	0.408	27 (90.0%)	8 (80.0%)	0.408
Present	3 (10.0%)	2 (20.0%)		3 (10.0%)	2 (20.0%)		3 (10.0%)	2 (20.0%)	
ASA class									
1	2 (6.7%)	0 (0.0%)	0.557	2 (6.7%)	0 (0.0%)	0.557	2 (6.7%)	0 (0.0%)	0.557
2	12 (40.0%)	4 (40.0%)		12 (40.0%)	4 (40.0%)		12 (40.0%)	4 (40.0%)	
3	14 (46.7%)	4 (40.0%)		14 (46.7%)	4 (40.0%)		14 (46.7%)	4 (40.0%)	
4	2 (6.7%)	2 (20.0%)		2 (6.7%)	2 (20.0%)		2 (6.7%)	2 (20.0%)	

ASA, American Society of Anesthesiologists; BMI, body mass index; CINPT, closed-incision negative-pressure therapy; COPD, chronic obstructive pulmonary disorder; DM, diabetes mellitus; F, female; M, male.

patients with colorectal surgery and found results similar to those of the present report: there was a marked reduction in the rates of SSIs using CINPT. Moreover, Zaidi *et al.* [15] reported a marked reduction in the incidence of SSIs from 21 to 3% in high-risk patients who underwent general and colorectal surgeries procedures. Shen *et al.* [16] reported results that were different from ours when they performed a randomized clinical trial in patients who underwent intra-abdominal surgical oncological resection; they found no differences between both CINPT and control groups. Willy *et al.* [17] recommended using CINPT for the management of patients at high risk of SSIs.

We showed that using CINPT produced marked cost savings, more than standard wound care, which was similar to the results of previous studies [11,18–20].

These results showed the benefits of using CINPT in terms of cost savings in patients at high risk of developing SSIs [21].

Our study assessed the benefits of using CINPT in primarily closed wounds, which is similar to the results of Frazee *et al.*, as it is better to leave contaminated wounds open to allow it to heal by secondary intention. They demonstrated that CINPT induced faster wound healing [22].

NPWT acts by many mechanisms to promote wound healing [1,12].

The advantages of ciNPWT that might help to avoid adverse events were reducing shearing forces at approximated edges of the wound [23] and increasing blood flow and capillary venous oxygen saturation [24], in addition to reduction of tissue edema [25,26], through the creation of a negative pressure environment that inhibits seroma formation, thus decreasing bacterial infection and allowing wound contraction [27].Moreover, it creates a hypoxic environment and leads to an increase in circulating interleukin levels and expression of growth factors. This subsequently stimulates angiogenesis,

granulation tissue formation and remodeling of the extracellular matrix [25,28].

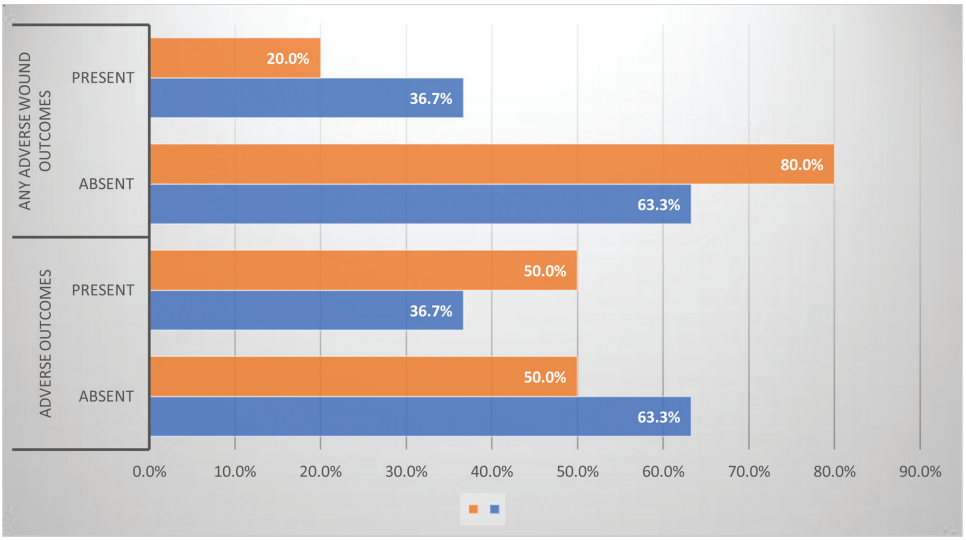
During the COVID-19 pandemic, CINPT could be considered a valuable method for reducing infection spread by formation of a clean wound area, reducing the frequency of changes required in the dressing and markedly decreasing the duration of hospital stay. However, to date, there are no sufficient data on the use of CINPT during the COVID-19 pandemic.

Despite the slightly different results of some reports, CINPT is currently considered a better management tool for the prevention of iSSIs [29,30]. More randomized studies are needed for determination of benefits and advantages of CINPT in colorectal, HPB and in gynecological oncology surgeries.

Conclusions

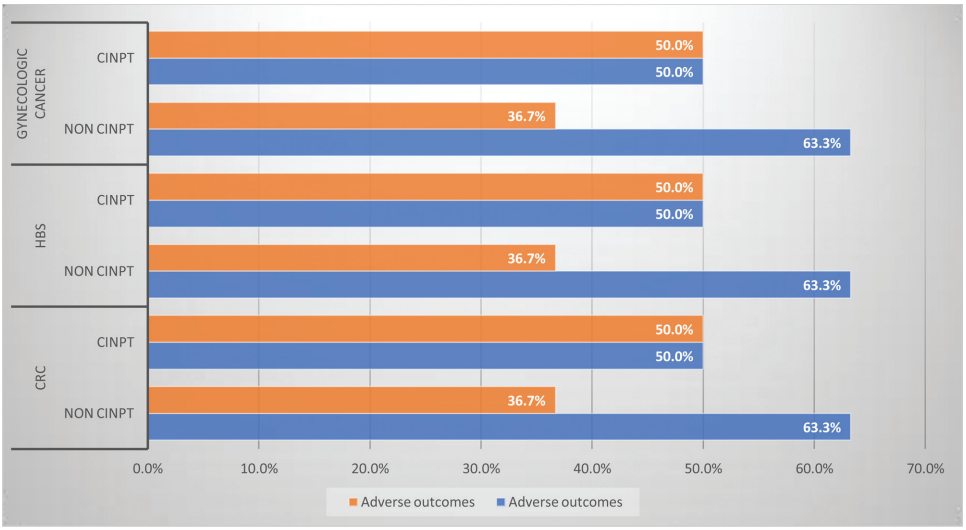
In the present report, we observed a marked reduction in the rates of SSIs in closed laparotomy wounds in colorectal, HPB and gynecological oncology surgeries managed with prophylactic CINPT. Our findings support the concept that use of CINPT dressings, particularly in high-risk patients, in both emergency and elective conditions might be considered beneficial for patients' recovery. Moreover, CINPT is considered

Figure 1



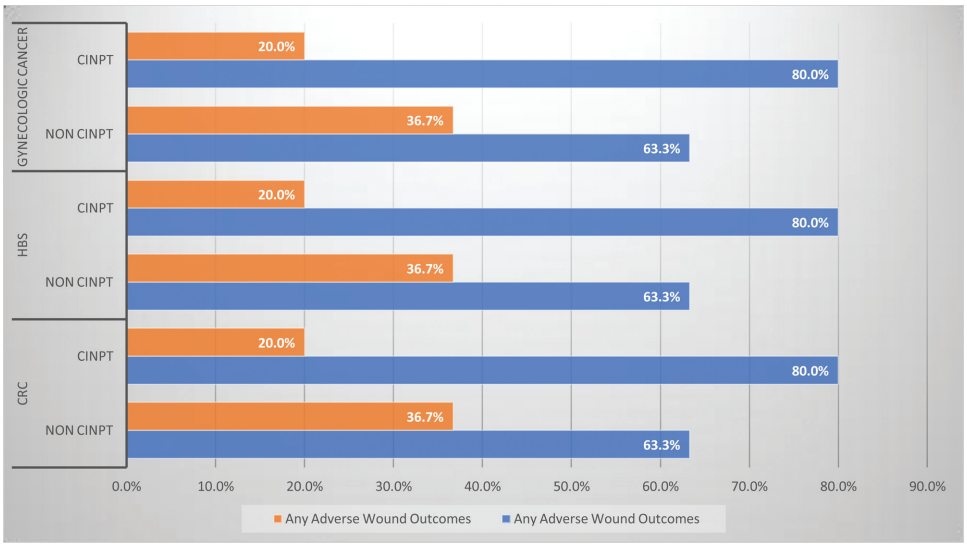
Differences in adverse surgical outcomes between all patients managed by standard non-closed-incision negative-pressure therapy (CINPT) or CINPT.

Figure 2



Differences in adverse surgical outcomes between patients who underwent open abdominal surgery for the management of colorectal cancer, hepatobiliary surgery or gynecologic cancer managed by standard non-closed-incision negative-pressure therapy (CINPT) or CINPT.

Figure 3



Differences in adverse wound outcomes between patients who underwent open abdominal surgery for the management of colorectal cancer, hepatobiliary surgery (HPS) or gynecologic cancer managed by standard non-closed-incision negative-pressure therapy (CINPT) or CINPT. Adverse wound outcomes: (1) superficial incisional SSI, (2) deep incisional SSI, (3) deep space/organ infection, (4) wound dehiscence, (5) seroma, (6) hematoma.

Table 3 Preoperative, operative and postoperative findings of all included patients and patients managed by standard non-CINPT or CINPT

Procedure	Standard		Total, *N*=120	*P* value
	Non-CINPT, *N*=90	CINPT, *N*=30		
Preoperative/postoperative stoma				
Absent	57 (63.3%)	6 (20.0%)	63 (52.5%)	<0.001
Present	33 (36.7%)	24 (80.0%)	57 (47.5%)	
Emergent surgery				
Absent	69 (76.7%)	18 (60.0%)	87 (72.5%)	0.077
Present	21 (23.3%)	12 (40.0%)	33 (27.5%)	
Elective operation, *n* (%)				
Absent	21 (23.3%)	12 (40.0%)	33 (27.5%)	0.077
Present	69 (76.7%)	18 (60.0%)	87 (72.5%)	
Operative time (min)	134 (95–155)	200 (180–260)	138 (95–260)	<0.001
Contaminated/dirty wound, *n* (%)				
Absent	39 (43.3%)	12 (40.0%)	51 (42.5%)	0.749
Present	51 (56.7%)	18 (60.0%)	69 (57.5%)	
Organ space SSI				
Absent	78 (86.7%)	24 (80.0%)	102 (85.0%)	0.376
Present	12 (13.3%)	6 (20.0%)	18 (15.0%)	
Adverse surgical outcomes				
Absent	57 (63.3%)	15 (50.0%)	72 (60.0%)	0.197
Present	33 (36.7%)	15 (50.0%)	48 (40.0%)	
Adverse surgical outcomes				
0	57 (63.3%)	15 (50.0%)	72 (60.0%)	0.004
1,2	6 (6.7%)	0 (0.0%)	6 (5.0%)	
1,2,3	3 (3.3%)	0 (0.0%)	3 (2.5%)	
1,2,6	0 (0.0%)	3 (10.0%)	3 (2.5%)	
2,3,4	12 (13.3%)	6 (20.0%)	18 (15.0%)	
2,6	6 (6.7%)	0 (0.0%)	6 (5.0%)	
4,5	6 (6.7%)	6 (20.0%)	12 (10.0%)	
Length of stay (days)	8 (6–9)	7 (5–8)	8 (5–9)	<0.001
Adverse wound outcome				
Absent	57 (63.3%)	24 (80.0%)	81 (67.5%)	0.049

(*Continued*)

Table3 (*Continued*)

Procedure	Standard		Total, *N*=120	*P* value
	Non-CINPT, *N*=90	CINPT, *N*=30		
Present	33 (36.7%)	6 (20.0%)	39 (32.5%)	
SSI				
Absent	71 (85%)	28 (93%)	99 (82.5%)	<0.001
Present	19 (15%)	2 (7%)	21 (17.5%)	
Need for wound exploration				
Absent	72 (80.0%)	24 (80.0%)	96 (80.0%)	1.000
Present	18 (20.0%)	6 (20.0%)	24 (20.0%)	

CINPT, closed-incision negative-pressure therapy; SSI, surgical-site infection.

Table 4 Preoperative, operative and postoperative findings of patients who underwent open abdominal surgery for the management of colorectal cancer (CRC), hepatobiliary surgery (HPS) or gynecologic cancer managed by standard non-CINPT or by CINPT

	Surgery								
	CRC, *N*=40		*P*	HBS, *N*=40		*P*	Gynecologic cancer, *N*=40		*P*
	Non-CINPT, *N*=30	CINPT, *N*=10		Non-CINPT, *N*=30	CINPT, *N*=10		Non-CINPT, *N*=30	CINPT, *N*=10	
Preoperative/postoperative stoma									
Absent	19 (63.3%)	2 (20.0%)	0.017	19 (63.3%)	2 (20.0%)	0.017	19 (63.3%)	2 (20.0%)	0.017
Present	11 (36.7%)	8 (80.0%)		11 (36.7%)	8 (80.0%)		11 (36.7%)	8 (80.0%)	
Emergent surgery									
Absent	23 (76.7%)	6 (60.0%)	0.307	23 (76.7%)	6 (60.0%)	0.307	23 (76.7%)	6 (60.0%)	0.307
Present	7 (23.3%)	4 (40.0%)		7 (23.3%)	4 (40.0%)		7 (23.3%)	4 (40.0%)	
Elective operation, *n* (%)									
Absent	7 (23.3%)	4 (40.0%)	0.307	7 (23.3%)	4 (40.0%)	0.307	7 (23.3%)	4 (40.0%)	0.307
Present	23 (76.7%)	6 (60.0%)		23 (76.7%)	6 (60.0%)		23 (76.7%)	6 (60.0%)	
Operative time (min)	134 (95–155)	200 (180–260)	<0.001	134 (95–155)	200 (180–260)	<0.001	134 (95–155)	200 (180–260)	<0.001
Contaminated/dirty wound, *n* (%)									
Absent	13 (43.3%)	4 (40.0%)	0.853	13 (43.3%)	4 (40.0%)	0.853	13 (43.3%)	4 (40.0%)	0.853
Present	17 (56.7%)	6 (60.0%)		17 (56.7%)	6 (60.0%)		17 (56.7%)	6 (60.0%)	
Organ space SSI									
Absent	26 (86.7%)	8 (80.0%)	0.609	26 (86.7%)	8 (80.0%)	0.609	26 (86.7%)	8 (80.0%)	0.609
Present	4 (13.3%)	2 (20.0%)		4 (13.3%)	2 (20.0%)		4 (13.3%)	2 (20.0%)	
Adverse surgical outcomes									
Absent	19 (63.3%)	5 (50.0%)	0.456	19 (63.3%)	5 (50.0%)	0.456	19 (63.3%)	5 (50.0%)	0.456
Present	11 (36.7%)	5 (50.0%)		11 (36.7%)	5 (50.0%)		11 (36.7%)	5 (50.0%)	
Adverse surgical outcomes									
0	19 (63.3%)	5 (50.0%)	0.375	19 (63.3%)	5 (50.0%)	0.375	19 (63.3%)	5 (50.0%)	0.375
1,2	2 (6.7%)	0 (0.0%)		2 (6.7%)	0 (0.0%)		2 (6.7%)	0 (0.0%)	
1,2,3	1 (3.3%)	0 (0.0%)		1 (3.3%)	0 (0.0%)		1 (3.3%)	0 (0.0%)	
1,2,6	0 (0.0%)	1 (10.0%)		0 (0.0%)	1 (10.0%)		0 (0.0%)	1 (10.0%)	
2,3,4	4 (13.3%)	2 (20.0%)		4 (13.3%)	2 (20.0%)		4 (13.3%)	2 (20.0%)	
2,6	2 (6.7%)	0 (0.0%)		2 (6.7%)	0 (0.0%)		2 (6.7%)	0 (0.0%)	
4,5	2 (6.7%)	2 (20.0%)		2 (6.7%)	2 (20.0%)		2 (6.7%)	2 (20.0%)	
Length of stay (days),	8 (6–9)	7 (5–8)	0.006	8 (6–9)	7 (5–8)	0.006	8 (6–9)	7 (5–8)	0.006
Any adverse wound outcome									
Absent	19 (63.3%)	8 (80.0%)	0.33	19 (63.3%)	8 (80.0%)	0.33	19 (63.3%)	8 (80.0%)	0.33
Present	11 (36.7%)	2 (20.0%)		11 (36.7%)	2 (20.0%)		11 (36.7%)	2 (20.0%)	
Need for wound exploration									
Absent	24 (80.0%)	9 (80.0%)	1	24 (80.0%)	8 (80.0%)	1	24 (80.0%)	8 (80.0%)	1
Present	6 (20.0%)	2 (20.0%)		6 (20.0%)	2 (20.0%)		6 (20.0%)	2 (20.0%)	

Adverse surgical outcomes: (1) reoperation, (2) readmission, (3) ICU admission, (4) urinary tract infection, (5) pneumonia, (6) anastomotic leak. CINPT, closed-incision negative-pressure therapy; SSI, surgical-site infection.

a cost-effective method for reducing the incidence of SSIs. SSIs were observed later on in the setting of use of CINPT, which shows that longer duration of wound surveillance is required.

We started the study in 2015 and hypothesized that CINPT will aid better management of SSIs than standard non-CINPT procedures. During the study, the pandemic occurred in 2020; thus, we came to the conclusion that during the COVID-19 pandemic, CINPT could decrease the spread of infections, the frequency of changes required of the dressing and the duration of hospital stay.

Recommendations

We recommend further large-scale prospective studies to prove the value of CINPT in reducing SSIs, particularly during the Covid-19 pandemic (Figs 1–3, Tables 3 and 4).

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Conflicts of interest

There are no conflicts of interest.

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