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Assessment of Bundle of Measures Perioperatively to Decrease the Incidence of Surgical Site Wound Infection in Patients Undergoing Abdominal Hysterectomies

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Abstract

Background: Surgical site infections (SSIs) are the second most common reason for unplanned hospital readmissions after hysterectomy and result in increased morbidity and health care costs. The estimated rate of SSI after hysterectomy varies between 1% and 4%. The objective of the study is to investigate if a bundle of perioperative measures (as stated earlier) reduces down the incidence of post-operative surgical site wound infection after abdominal hysterectomy. Materials and Methods: The present prospective study was carried out on total 200 women who were undergo hysterectomy in the operation theater of Department of Obstetrics and Gynecology of IPGMER and SSKM Hospital due to gynecological conditions requiring hysterectomy. Four perioperative bundles of measures are considered – 1. chlorhexidine gluconate and Cetrimide solution (Savlon) wash of the operative field 1 h before the operation, 2. administration of single dose antibiotic (Inj. Ceftriaxone 1 g intravenous) 1 h or less before the incision, 3. vaginal wash with povidone-iodine, and 4. sterile dressing is to be maintained and removed postoperatively after 48 h. Result: We found that in case, 94 (94.0%) patients had Ceftriaxone and 6 (6.0%) patients had clindamycin and gentamicin. In control, 96 (96.0%) patients had ceftriaxone and 4 (4.0%) patients had clindamycin and gentamicin. Association of choice of antibiotic versus group was not statistically significant ($P = 0.5164$). In case, 6 (6.0%) patients had wound gaping. In control, 11 (11.0%) patients had wound gaping. Association of wound gaping versus group was statistically significant ($P = 0.048$). Conclusion: The present study found that hospital stay was more in control compared to case which was statistically significant. Fever was more in control compared to case which was statistically significant. In this study, local wound discharge was more in control compared to case which was statistically significant. It was found that wound gaping was more in control compared to case which was statistically significant.

Keywords: Surgical site infections, Hysterectomy, Wound gaping, Hospital stay

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Background

Surgical site infections (SSIs) are the second most common reason of hospital readmissions after hysterectomy and result in increased morbidity and health care costs. A pilot project aiming at finding the percentage of post-hysterectomy wound infections was undertaken in IPGME and R SSKMH for the past 6 months and it was found that a shocking 15% of the patients had wound complications. The objective of my initiative is to drive the rate below. For this, a prevention bundle will be created that includes –

1. Chlorhexidine gluconate and Cetrimide solution (Savlon) wash of the operative field 1 h before the operation.
2. Administration of single dose antibiotic (Inj. Ceftriaxone 1 g intravenous [IV]) 1 h or less before the incision.
   Patients with cephalosporin or penicillin allergies will be given 900 mg IV clindamycin and 2 mg/kg of body weight IV gentamicin instead of ceftriaxone. The addition of 500 mg IV metronidazole preoperatively for cases, in which bowel involvement is anticipated/procedures anticipated to be longer or at higher risk for infection/patients undergoing concurrent lymph node dissection or omentectomy (as there is higher risk for anaerobic infection).
3. Vaginal wash with povidone-iodine.
4. Sterile dressing is to be maintained and removed postoperatively after 48 h.

SSIs are the second most common reason for unplanned hospital readmissions after hysterectomy[1,2] and result in increased morbidity and health care costs. The estimated rate of SSI after hysterectomy varies between 1% and 4%.[3-5] SSI rates in hysterectomy have been publicly reported for 2013 and, for January 2014; reimbursements may be withheld by the Centers for Medicare and Medicaid Services if the rates exceed expected values.[6] A pilot project aiming at finding the percentage of post-hysterectomy wound infections was undertaken in IPGME and R SSKMH for the past 6 months and it was found that a shocking 15% of the patients had wound complications. The objective of my initiative is to drive the rate below. A prevention bundle was created that included chlorhexidine gluconate and Cetrimide (Savlon) impregnated wipes, standardized pre-operative skin preparation and antibiotic dosing, dressing maintenance, and direct feedback when the protocol was breached.

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Among major gynecologic surgical procedures, hysterectomy is the most prevalent procedure on a worldwide basis. Hysterectomies can be performed abdominally, vaginally, or laparoscopic ally, and given the large amount in hospital charges resulting from this procedure annually, the outcomes and costs associated with these various approaches are important considerations for health care decision makers.

Clinical evidence supports the notion that less invasive vaginal or laparoscopic hysterectomies are associated with fewer complications, shorter hospitalizations, and a more rapid return of patients to normal activities than is open abdominal hysterectomy.[7,8] The American College of Obstetrics and Gynecology Committee on Gynecologic Practice has reached a similar conclusion. Among the established benefits of a less invasive, approach to hysterectomy is the lower incidence of associated wound or abdominal infections than with open abdominal hysterectomy.[9]

However, despite the evidence, practice guidelines, and seemingly obvious benefits of less invasive procedures for hysterectomy with regard to clinical, economic, and humanistic outcomes, only one in three hysterectomies are currently performed with such procedures.[10] It is, therefore, important to continue to further strengthen the body of evidence for less invasive hysterectomy procedures.

SSIs, if they occur, can largely determine the rapidity and ease of recovery after hysterectomy. Although fever in the first 24 h postoperatively may largely be explained by the release of inflammatory cytokines associated with incision, reports have shown that fever caused by abscess and cellulitis from SSI and occurring a few days following gynecologic surgery is not uncommon.[11] Patients undergoing abdominal hysterectomy are more likely to experience febrile morbidity than those who undergo vaginal hysterectomy.[12]

Monitoring for SSI following hysterectomy procedures, and developing processes to reduce its risk, has become increasingly important. Readmissions associated with SSIs could also offer an efficient measure of the quality of health care provision and the related financial effect on hospitals.

The objective of the study is to investigate if a bundle of perioperative measures (as stated earlier) reduces down the incidence of post-operative surgical site wound infection after abdominal hysterectomy.

Materials and Methods

Inclusion Criteria

The present prospective study was carried out on total 200 women who were undergo hysterectomy in the operation theater of Department of Obstetrics and Gynecology of IPGMER and SSKM Hospital due to gynecological conditions requiring hysterectomy.

Exclusion Criteria

The following criteria were excluded from the study:

- Patients who are-immunosuppressed
- Diabetic
- H/O smoking
- Long pre-operative hospital stays
- Hematological disorders, and
- Other conditions increasing the patient's susceptibility toward infection.

Methods

Four perioperative bundles of measures are considered-

1. Chlorhexidine gluconate and Cetrimide solution (Savlon) wash of the operative field 1 h before the operation.
2. Administration of single dose antibiotic (Inj. Ceftriaxone 1 g IV) 1 h or less before the incision.
   Patients with cephalosporin or penicillin allergies were given 900 mg IV clindamycin and 2 mg/kg of body weight IV gentamicin instead of ceftriaxone. The addition of 500 mg IV metronidazole preoperatively for cases, in which bowel involvement is anticipated/procedures anticipated to be longer or at higher risk for infection/patients undergoing concurrent lymph node dissection or omentectomy (as there is higher risk for anaerobic infection).
3. Vaginal wash with povidone-iodine.
4. Sterile dressing is to be maintained and removed postoperatively after 48 h.

Study Setting

Women who were undergo hysterectomy in the operation theater of Department of Obstetrics and Gynecology of IPGMER and SSKM Hospital due to gynecological conditions requiring hysterectomy.

Study Design

It is a prospective study.

Time Line

This study was 1 year (April 2019–March 2020).

Sample Size

The sample size is as follows:

Two hundred (100 patients were undergo the proposed bundle of measures and the rest 100 patients were receive conventional perioperative measures taken in IPGME and R SSKMH).

Statistical Analysis

For statistical analysis, data were entered into a Microsoft Excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Two-sample *t*-tests for a difference in mean involved independent samples or unpaired samples. Paired *t*-tests were a form of blocking and had greater power than unpaired tests. A Chi-squared test ($\chi 2$ test) was any statistical hypothesis test, wherein the sampling distribution of the test statistic is a Chi-squared distribution when the null hypothesis is true. Without other qualification, "chi-squared test" often is used as short for Pearson's Chi-squared test. Unpaired proportions were compared by Chi-square test or Fischer's exact test, as appropriate.

Explicit expressions that can be used to carry out various t-tests are given below. In each case, the formula for a test statistic that either exactly follows or closely approximates a t-distribution under the null hypothesis is given. Furthermore, the appropriate degrees of freedom are given in each case. Each of these statistics can be used to carry out either a one-tailed test or a two-tailed test.

Once a *t*-value is determined, *P*-value can be found using a table of values from Student's t-distribution. If the calculated *P*-value is below the threshold chosen for statistical significance (usually 0.10, 0.05, or 0.01 level), then the null hypothesis is rejected in favor of the alternative hypothesis.

P-value ≤ 0.05 was considered for statistically significant.

Result and Analysis

Our study showed that in case, the mean age (mean ± s.d.) of patients was 52.7000 ± 4.4733. In control, the mean age (mean ± s.d.) of patients was 53.0000 ± 4.4947. Difference of mean age with both group was not statistically significant (*P* = 0.6367). In case, 68 (68.0%) patients were Hindu and 32 (32.0%) patients were Muslim. In control, 64 (64.0%) patients were Hindu and 36 (36.0%) patients were Muslim. Association of sex versus group was not statistically significant (*P* = 0.5504).

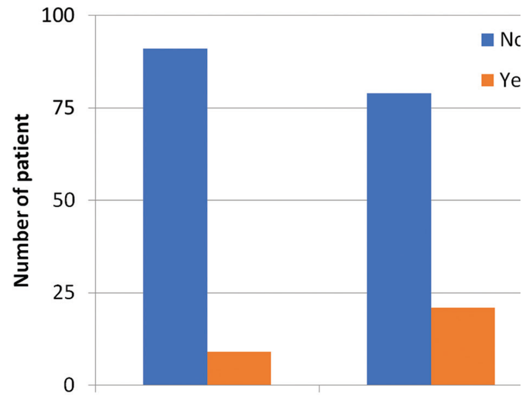
We found that, in case, 43 (43.0%) patients were from low class status, 39 (39.0%) patients were from middle class status, and 18 (18.0%) patients were from high class status. In control, 41 (41.0%) patients were from low class status, 38 (38.0%) patients were from middle class, and 21 (21.0%) patients were from high class status. Association of socioeconomic status versus group was not statistically significant (*P* = 0.8644). In case, 68 (68.0%) patients were from rural area and 32 (32.0%) patients were from urban area. In control, 72 (72.0%) patients were from rural area and 28 (28.0%) patients were from urban area. Association of locality versus group was not statistically significant (*P* = 0.5370).

It was found that, in case, the mean body mass index (BMI) (mean ± s.d.) of patients was 26.9600 ± 2.3069. In control, the mean BMI (mean ± s.d.) of patients was 26.5700 ± 2.6724. Difference of mean BMI with both group was not statistically significant (*P* = 0.2706). In case, 94 (94.0%) patients had Ceftriaxone and 6 (6.0%) patients had clindamycin and gentamicin. In control, 96 (96.0%) patients had Ceftriaxone and 4 (4.0%) patients had clindamycin and gentamicin. Association of choice of antibiotic versus group was not statistically significant (*P* = 0.5164).

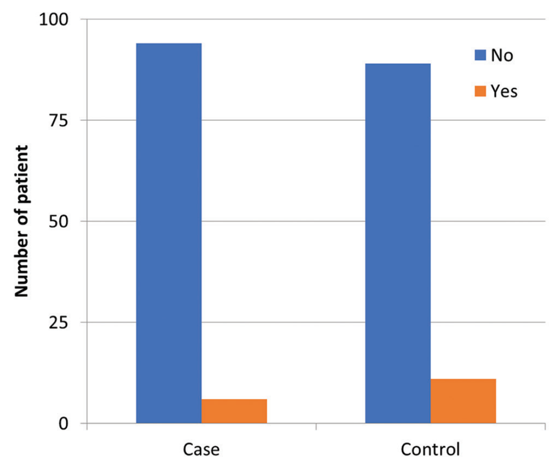
We found that, in case, the mean operation duration (mean ± s.d.) of patients was 83.3500 ± 9.3489. In control, the mean operation duration (mean ± s.d.) of patients was 85.5000 ± 13.9353. Difference of mean operation duration with both group was not statistically significant (*P* = 0.2016). In case, 11 (11.0%) patients had fever. In control, 23 (23.0%) patients had fever. Association of fever versus group was statistically significant (*P* = 0.0238).

Our study showed that in case, 9 (9.0%) patients had local wound discharge. In control, 21 (21.0%) patients had local wound discharge. Association of local wound discharge versus group was statistically significant (*P* = 0.0174). In case, 6 (6.0%) patients had wound gaping. In control, 11 (11.0%) patients had wound gaping. Association of wound gaping versus group was statistically significant (*P* = 0.048).

In our study in case, the mean hospital stay duration (mean ± s.d.) of patients was 6.6000 ± 2.0000. In control, the mean hospital stay duration (mean ± s.d.) of patients was 7.2800 ± 2.6594. Difference of mean hospital stay duration with both group was statistically significant (*P* = 0.0423).



Association between Local wound discharge



Association between wound gaping

Distribution of mean age, BMI, operation duration, and hospital stay duration: Group

	Number	*Mean*	*SD*	*Minimum*	*Maximum*	*Median*	*P-value*
Age							
Case	100	52.7000	4.4733	48.0000	62.0000	51.5000	0.6367
Control	100	53.0000	4.4947	46.0000	60.0000	52.5000	
BMI							
Case	100	26.9600	2.3069	23.4000	31.1000	26.4500	0.2706
Control	100	26.5700	2.6724	22.5000	31.8000	26.3000	
Operation duration							
Case	100	83.3500	9.3489	65.0000	100.0000	82.5000	0.2016
Control	100	85.5000	13.9353	60.0000	115.0000	85.0000	
Hospital stay duration							
Case	100	6.6000	2.0000	6.0000	14.0000	6.0000	0.0423
Control	100	7.2800	2.6594	6.0000	14.0000	6.0000	

Association between choice of antibiotic, fever, local wound discharge, and wound gaping: Group

		Group		*Total*	*Chi-square value*	*P-value*
		Case	*Control*			
Choice of Antibiotic	Ceftriaxone	94	96	190	0.4211	0.5164
	Row%	49.5	50.5	100.0		
	Col %	94.0	96.0	95.0		
	Clindamycin and Gentamicin	6	4	10		
	Row %	60.0	40.0	100.0		
	Col %	6.0	4.0	5.0		
	Total	100	100	200		
	Row %	50.0	50.0	100.0		
	Col %	100.0	100.0	100.0		
Fever	No	89	77	166	5.1028	0.0238
	Row %	53.6	46.4	100.0		
	Col %	89.0	77.0	83.0		
	Yes	11	23	34		
	Row %	32.4	67.6	100.0		
	Col %	11.0	23.0	17.0		
	Total	100	100	200		
	Row %	50.0	50.0	100.0		
	Col %	100.0	100.0	100.0		
Local wound discharge	No	91	79	170	5.6471	0.0174
	Row %	53.5	46.5	100.0		
	Col %	91.0	79.0	85.0		
	Yes	9	21	30		
	Row %	30.0	70.0	100.0		
	Col %	9.0	21.0	15.0		
	Total	100	100	200		
	Row %	50.0	50.0	100.0		
	Col %	100.0	100.0	100.0		
Wound gaping	No	94	89	183	1.6072	0.048
	Row %	51.4	48.6	100.0		
	Col %	94.0	89.0	91.5		
	Yes	6	11	17		
	Row %	35.3	64.7	100.0		
	Col %	6.0	11.0	8.5		
	Total	100	100	200		
	Row %	50.0	50.0	100.0		
	Col %	100.0	100.0	100.0		

Discussion

Our study showed that in case, the mean age (mean ± s.d.) of patients was 52.7000 ± 4.4733. In control, the mean age (mean ± s.d.) of patients was 53.0000 ± 4.4947. Difference of mean age with both group was not statistically significant (*P* = 0.6367). In case, the mean BMI (mean ± s.d.) of patients was 26.9600 ± 2.3069. In control, the mean BMI (mean ± s.d.) of patients was 26.5700 ± 2.6724. Difference of mean BMI with both group was not statistically significant (*P* = 0.2706). In case, the mean operation duration (mean ± s.d.) of patients was 83.3500 ± 9.3489. In control, the mean operation duration (mean ± s.d.) of patients was 85.5000 ± 13.9353. Difference of mean operation duration with both group was not statistically significant (*P* = 0.2016). In case, the mean hospital stay duration (mean ± s.d.) of patients was 6.6000 ± 2.0000. In control, the mean hospital stay duration (mean ± s.d.) of patients was 7.2800 ± 2.6594. Difference of mean hospital stay duration with both group was statistically significant (*P* = 0.0423). In case, 68 (68.0%) patients were Hindu and 32 (32.0%) patients were Muslim. In control, 64 (64.0%) patients were Hindu and 36 (36.0%) patients were Muslim. Association of sex versus group was not statistically significant (*P* = 0.5504).

Young *et al.*[1] (2013) found that 21 of 192 patients (10.7%) developed an SSI in the pre-intervention period, whereas 1 of 84 patients (1.2%) developed an SSI in the post-intervention period (*P* = 0.006). SSI was associated with obesity (a BMI ≥30) (11.5% vs. 4.8%, *P* = 0.04), receipt of a blood transfusion (18.2% vs. 6.6%, *P* = 0.03), and abdominal skin preparation with PI as opposed to CHG (10.1% vs. 2.0%, *P* = 0.07). Chlorhexidine gluconate was used more commonly for abdominal skin preparation in the post- than in the pre-intervention period (6.6% pre-intervention vs. 50.7% post-intervention, *P* < 0.0001). A multifaceted intervention decreased dramatically the rate of SSI after abdominal hysterectomy at their institution. No single component of the intervention could be identified as most responsible for the improvement.

Andiman *et al*[13]] (2018) observed by analysisng multivariate regression that there was no statistically significant difference in post-operative days of hospital stay (adjusted mean ratio 0.95, P = 0.09) or rate of readmission for SSI-specific symptom.

De Lissovoy *et al.*[4] (2009) found that SSI is associated with a significant economic burden in terms of extended length of stay and increased costs of treatment.

Roy *et al.*[5] (2014) found that patients with an SSI experienced a three- to five-fold greater LOS, two-fold greater cost, and three-fold greater risk of hospital readmission than those without an SSI. In addition to other documented benefits of such less invasive procedures, the lower incidence of SSIs and lower rates of associated complications and costs with these procedures than with open abdominal hysterectomy should be taken into account when weighing the risks and benefits of a surgical approach for patients whose condition warrants hysterectomy.

Keenan *et al*.[14] (2014) showed that no significant difference was observed in deep SSIs, organ-space SSIs, wound disruption, length of stay, 30-day readmission, or variable direct costs between the matched groups. However, in a subgroup analysis of the post-bundle period, superficial SSI occurrence was associated with a 35.5% increase in variable direct costs ($13 253 vs. $9779, $P = 0.001$) and a 71.7% increase in length of stay (7.9 vs. 4.6 days, $P < 0.001$). The preventive SSI bundle was associated with a substantial reduction in SSIs after colorectal surgery. The increased costs associated with SSIs support that the bundle represents an effective approach to reduce health care costs.

Pop-Vicas *et al*.[15] (2017) showed that higher median length of hospital stay increased SSI risk ($P < 0.05$ for all). Duration of surgery was the only independent risk factor for SSI identified on multivariate analysis (odds ratio, 3.45; 95% confidence interval, 1.21–9.76; $P = 0.02$). In their population of women with multi-morbidity and hysterectomies largely due to underlying gynecologic malignancies, duration of surgery, presumed a marker of surgical complexity, is a significant SSI risk factor. The choice of pre-operative antibiotic did not alter SSI risk in their study.

We showed that in case, 43 (43.0%) patients were low class, 39 (39.0%) patients were middle class, and 18 (18.0%) patients were high class. In control, 41 (41.0%) patients were low class, 38 (38.0%) patients were middle class, and 21 (21.0%) patients were high class. Association of socioeconomic status versus group was not statistically significant ($P = 0.8644$). In case, 68 (68.0%) patients were from rural area and 32 (32.0%) patients were from urban area. In control, 72 (72.0%) patients were from rural area and 28 (28.0%) patients were from urban area. Association of locality versus group was not statistically significant ($P = 0.5370$). In case, 94 (94.0%) patients had ceftriaxone and 6 (6.0%) patients had clindamycin and gentamicin. In control, 96 (96.0%) patients had ceftriaxone and 4 (4.0%) patients had clindamycin and gentamicin. Association of choice of antibiotic versus group was not statistically significant ($P = 0.5164$).

Guo *et al*.[16] (2020) found that 515 hysterectomies in the same period before bundle implementation representing a decrease in SSI rate from 2.7% to 0.4% (odds ratio, 7.41; 95% confidence interval, 1.67–32.75). The two SSIs in the post-bundle period occurred in open hysterectomies, whereas 8 (57.1%) SSIs in the pre-bundle period occurred in minimally invasive hysterectomies. An SSI prevention bundle was effective for reducing the SSI rate in hysterectomy for both benign and malignant indications.

Olsen *et al*.[17] (2009) found that longer operative time and lack of private health insurance were marginally associated with SSI. A specific risk stratification index could help to more accurately predict the risk of incisional SSI following abdominal hysterectomy.

We found that in case, 11 (11.0%) patients had fever. In control, 23 (23.0%) patients had fever. Association of fever versus group was statistically significant ($P = 0.0238$). In case, 9 (9.0%) patients had local wound discharge. In control, 21 (21.0%) patients had local wound discharge. Association of local wound discharge versus group was statistically significant ($P = 0.0174$). In case, 6 (6.0%) patients had wound gaping. In control, 11 (11.0%) patients had wound gaping. Association of wound gaping versus group was statistically significant ($P = 0.048$).

The risk of infection continues even after the patient leaves the hospital. Caregivers should educate the patient and relatives regarding proper incision care, how to recognize signs of SSI and the importance of reporting symptoms to their surgeons as well as primary care providers. Take-home materials should be easy-to-read and available in multiple languages.

It is also important to coordinate post-discharge SSI surveillance activities between the facility's infection prevention program, the surgeon, the surgical unit, and possible referral or readmission centers so that accurate statistics can be collected on the incidence of SSI by types of patients, surgeries, and surgeons. Considering that more than half of all surgeries are performed in outpatient settings and more than 65% of all inpatient surgery SSIs are identified after the patient leaves the facility, it is very easy to significantly underestimate SSI rates and miss serious infection issues.[18,19]

Conclusion

We found that age and BMI were not significant difference in two groups.

We also found that religion, socioeconomic status, locality, and choice of antibiotic were not significant difference both case and control.

It was found that the mean operation duration was more in control compared to case though it was not statistically significant.

The present study found that hospital stay was more in control compared to case which was statistically significant.

Fever was more in control compared to case which was statistically significant.

In this study, local wound discharge was more in control compared to case which was statistically significant.

It was found that wound gaping was more in control compared to case which was statistically significant.

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