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Incidence and Risk Factors of Surgical Site Infections after Abdominal Hysterectomy for Benign Diseases

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ABSTRACT

Objectives: To study incidence and risk factors of surgical site infection (SSI) after abdominal hysterectomy for benign diseases.

Materials and Methods: Retrospective study of 82 patients who underwent abdominal hysterectomies for benign diseases between September 2013 and October 2017 at Warinchumrab General Hospital was performed. SSI was defined using the Centers for Disease Control and Prevention criteria. Independent risk factors of SSI after the abdominal hysterectomy were identified by multivariate regression analysis.

Results: Incidences of SSI after abdominal hysterectomy was 9.76% (N = 82). There were 8 superficial incisional SSI, no deep incisional and organ-space SSI. Risk factor associated with superficial incisional SSI was a BMI ≥ 23.0 kg/m^2 (odds ratio 1.154 [95% confidence interval 1.045-1.274], p = 0.021).

Conclusion: Incidence of SSI after abdominal hysterectomy was 9.76% and the significant risk factor in our study was BMI ≥ 23.0 kg/m^2

Keywords: SSI, abdominal hysterectomy, benign disease.

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อุบัติการณ์และปัจจัยเสี่ยงของการติดเชื้อหลังผ่าตัดมดลูกออกทางหน้าท้อง ในการรักษาเนื้องอกชนิดธรรมดา

ปุณณดา อธิบวรสุข

บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาอุบัติการณ์และปัจจัยเสี่ยงของการติดเชื้อหลังผ่าตัดมดลูกออกทางหน้าท้อง ในการรักษาเนื้องอกชนิดธรรมดา

วัสดุและวิธีการ: การศึกษาวิจัยครั้งนี้ได้ทำการศึกษาวิจัยแบบย้อนหลัง (Retrospective study) ในผู้ป่วยจำนวน 82 คน ที่โรงพยาบาลวารินชำราบ ซึ่งได้รับการวินิจฉัยว่าเป็นโรคเนื้องอกชนิดธรรมดาของมดลูกและได้รับการผ่าตัดมดลูกและปากมดลูกออกทั้งหมดทางหน้าท้อง ได้ทำการศึกษาวิจัยตั้งแต่ เดือนกันยายน 2556 ถึง เดือน ตุลาคม 2560 การติดเชื้อแผลผ่าตัด (Surgical site infection) หมายถึง การติดเชื้อแผลผ่าตัดที่เกิดภายใน 30 วัน หลังผ่าตัด [Centers for Disease Control and Prevention criteria] ปัจจัยเสี่ยงอิสระต่างๆ ที่ทำให้เกิดการติดเชื้อแผลผ่าตัดได้นำมาวิเคราะห์โดยใช้การวิเคราะห์การถดถอยพหุคูณ (multivariate regression analysis)

ผลการศึกษา: พบว่าผู้ป่วยมีอุบัติการณ์การติดเชื้อหลังผ่าตัดมดลูกออกทางหน้าท้อง 9.76% และพบเฉพาะการติดเชื้อชั้นตื้น (Superficial incisional surgical site infection) เท่านั้น ไม่พบการติดเชื้อชั้นลึก (Deep incisional surgical site infection) และการติดเชื้ออวัยวะ (Organ-space surgical site infection) แต่อย่างใด สำหรับปัจจัยเสี่ยงของการติดเชื้อแผลผ่าตัดในการศึกษาครั้งนี้พบว่า ผู้ป่วยที่มีค่าดัชนีมวลกาย (Body mass index) ≥ 23.0 กิโลกรัม/เมตร^2 เป็นปัจจัยเสี่ยงอย่างมีนัยสำคัญทางสถิติ โดยการวิเคราะห์ทางสถิติใช้วิธีการวิเคราะห์การถดถอยพหุคูณ (Odds ratio 1.154 [1.045-1.274], p = 0.021)

สรุป: ในการศึกษาวิจัยครั้งนี้ พบว่าอุบัติการณ์การติดเชื้อแผลผ่าตัด 9.76% และพบว่าดัชนีมวลกายของผู้ป่วยตั้งแต่ หรือมากกว่า 23.00 กิโลกรัม/เมตร^2 เป็นปัจจัยเสี่ยงที่มีนัยสำคัญทางสถิติของผู้ป่วยโรคเนื้องอกชนิดธรรมดาของมดลูกและได้รับการรักษาโดยการผ่าตัดมดลูกและปากมดลูกออกทั้งหมดทางหน้าท้อง

คำสำคัญ: การติดเชื้อแผลผ่าตัด, การผ่าตัดมดลูกและปากมดลูกทางหน้าท้อง, เนื้องอกชนิดธรรมดา

Introduction

Hysterectomy has become the most common gynecological procedure. Complications of hysterectomy vary based on the route of surgery and surgical techniques. The most common complications of a hysterectomy is infection, 10.5% for abdominal hysterectomy[1-3]. The development of surgical site infections (SSI) result in significant patient morbidity. Gynecologic procedures pose a unique challenge in that potential pathogenic microorganisms from skin or vagina and endocervix may migrate to operative sites and can result in vaginal cuff cellulitis, pelvic cellulitis, and pelvic abscess[4].

The purpose of this study was to evaluate the risk factors and incidences of SSIs after abdominal hysterectomy for benign diseases.

Materials and Methods

The studied patients were those who had undergone abdominal hysterectomy surgery for benign tumors between September 2013 and October 2017 at Warinchamrab General Hospital in Ubonratchathani province, Thailand. The present study was conducted retrospectively by reviewing the medical records of 82 patients, and approved by the Medical Research Ethics Committee of the Warinchumrab General Hospital (REC protocol number 03/2017). Data collection included age, diagnosis, uterine weight, surgical procedure, operative time, presence of co-morbidity, preoperative anemia, American Society of Anesthesiologists (ASA) class, intraoperative blood loss, type of anesthesia, and body mass index (BMI). Exclusion criteria included 1) pregnant women, 2) previous surgical procedures within 30 days prior to hysterectomy, 3) women with diagnosis of preoperative infection prior to hysterectomy, 4) women with the diagnosis of gynecologic cancer.

The Centers for Disease Control and Prevention (CDC) define SSI after gynecologic surgery as an infection occurring within 30 days of an operation occurring one of 3 locations: superficial at the incision site, deep at the incision site, or in other organs or spaces opened or manipulated during an operation[4]. It defined as superficial SSI if an infection that involved only skin or subcutaneous tissue of the surgical incision.

All patients in study were prescribed a single 1 gram dose of cefazolin intravenously within an hour before their surgery and preoperative, preparation of the skin with chlorhexidine gluconate to reduce the risk of SSI.

We categorized patients into 2 groups on the basis of 30 days postoperative SSI after hysterectomy, superficial incisional SSI included vaginal cuff cellulitis (group A), and no superficial incisional SSI included vaginal cuff cellulitis (group B).

Statistical analysis

The group A and group B demographic data were compared using unpaired student t-test. Categorical variables were examined using chi-square analysis and to determine risk factors for SSI. We performed multivariate regression analysis identified risk factors of SSI. Odds ratio was adjust for patient demographics and clinical characteristics. The values were expressed as mean ± standard deviation (SD) for parametric distribution, and median and interquartile range for non-parametric distribution. Two tailed p value were used, and $p < 0.05$ was considered to be statistically significant.

Results

Incidence of SSI after abdominal hysterectomy for benign diseases were 9.76% (n/N = 8/82). In our study, we found superficial incisional SSI included vaginal cuff cellulitis in all 8 patients who had SSI, no patients had deep incisional SSI included pelvic cellulitis or organ-space included adnexal infection and pelvic abscess. Demographic and clinical characteristics of 82 patients are expressed in Table 1. On the basis of SSI, 8 patients with superficial incisional SSI included vaginal cuff cellulitis (group A) and 74 patients without SSI (group B) were compared. The mean age of the patients was 46.0 ± 4.0 years in group A and 46.4 ± 5.5 years in group B. The most common indication of hysterectomy in both groups was myoma uteri, 75.0% in group A and 75.7% in group B, respectively. The median uterine weight of patients in group A was 260 grams (range 140-480) and 340 grams (range 160-603) in group B. The most surgical procedure of patients in group A was total abdominal hysterectomy (TAH) (62.2%) but in group B was TAH with bilateral salpingo-oophorectomy (BSO) (75.0%).

The median operative time was 82.5 min (range 76-88) in group A and 81.5 min (range 70-100) in group B. The most common comorbidity of the patients in group A was diabetes mellitus (37.5%) but in group B was thalassemia (14.9%). The most common type of anesthesia of the patients in both groups was general anesthesia, 87.5% in group A and 74.3% in group B, respectively. The mean BMI of the patients in group A was 28.2 ± 3.0 kg/m^2 and 25.4 ± 4.4 kg/m^2 in group B. The mean of preoperative anemia was hematocrit 34.9 ± 8.0% in group A and 35 ± 5.6% in group B. The most common classification of ASA in the patients of both groups was class two, 100.0% in group A and 71.6% in group B, respectively. The median intraoperative blood loss in the patients in both groups was 150 ml (range 150-200) in group A and 125 ml (range 50-200) in group B respectively.

Table 1. Demographic and clinical characteristics of 30 days post-operative superficial SSI after abdominal hysterectomy (N=82).

Variable	Superficial SSI (Group A, N=8)	No SSI (Group B, N=74)	p value
- Age (years) (mean ± S.D.)	46 ± 4.0	46.4 ± 5.5	0.836
- Diagnosis			0.686
- Myoma uteri	6 (75.0)	56 (75.7)	
- Endometriosis	2 (25.0)	8 (10.8)	
- Myoma uteri and endometriosis	0	8 (10.8)	
- Others	0	2 (2.7)	
- Uterine weight (grams): median (range)	260 (140-480)	340 (160-603)	0.755
- Surgical procedure			0.430
- TAH	6 (75.0)	28 (37.8)	
- TAH with BSO	2 (25.0)	46 (62.2)	
- Operation time (minutes): median (range)	82.5 (76-88)	81.5 (70-100)	0.648
- Comorbidity			0.882
- No Comorbidity	3 (37.5)	38 (51.5)	
- Hypertension	0	5 (6.8)	
- Hypertension and dyslipidemia	1(12.5)	5 (6.8)	
- Diabetes mellitus	3 (37.5)	4 (5.4)	
- Dyslipidemia	0	2 (2.7)	
- Thalassemia	0	11 (14.9)	
- Others	1(12.5)	9 (12.2)	
- Type of anesthesia			0.410
- General	7 (87.5)	55 (74.3)	
- Spinal block	1 (12.5)	19 (25.7)	
- BMI (kg/m^2) (mean ± S.D.)	28.2 ± 3.0	25.4 ± 4.4	0.076
- Preoperative GFR (ml/min/1.73 m^2) (mean ± S.D.)	105.4 ± 13.6	104.0 ± 11.4	0.754
- Preoperative anemia (% hematocrit) (mean ± S.D.)	34.9 ± 7.6	35.0 ± 5.6	0.955
- ASA (class)			0.384
- Class 1	0	16 (21.6)	
- Class 2	8 (100.0)	53 (17.6)	
- Class 3	0	4 (5.4)	
- Class 4	0	1 (1.4)	
- Intraoperative blood loss (ml): median (range)	150 (150-200)	125 (50-200)	0.942

All values listed as n (%), mean + standard deviation (SD) and median (range)
SSI: surgical site infection, BM: body mass index, GFR: glomerular filtration rate, ASA: American Society of Anesthesiologists, TAH: total abdominal hysterectomy, BSO: bilateral salpingo-oophorectomy

From Table 1, there were no significant difference between group A and group B regarding to age, diagnosis, uterine weight, surgical procedure, operative time, comorbidity, type of anesthesia, BMI, preoperative anemia, ASA class and intraoperative blood loss. We performed multivariate regression analysis to evaluate the risk factors for SSI after the abdominal hysterectomy for benign diseases (Table 2). We found that the BMI was statistically the significant risk factor associated with SSI with odds ratio (ORs) 1.154, 95% confidence interval (CI) 1.045-1.274, p = 0.021.

The multivariate regression analysis showed that age, diagnosis, uterine weight, surgical procedure, operative time, comorbidity, type of anesthesia, preoperative anemia, ASA class and intraoperative blood loss had no influence on SSI.

Table 2. Factor for superficial SSI after abdominal hysterectomy (multivariate regression analysis).

Variables	Multivariate		p value
	Odds ratio	95% CI	
- Age (years)	0.317	0.037-2.726	0.426
- 31-49			
- 50-55			
- Diagnosis	0.600	0.027-13.567	0.813
- Uterine weight (grams)	2.591	0.292-23.019	0.664
- Surgical procedure	0.203	0.038-1.076	0.061
- TAH			
- TAH with BSO			
- Operative time(mins)	1.189	0.222-6.367	0.838
- 55-74			
- 75-185			
- Comorbidity	1.759	0.392-7.902	0.712
- Type of anesthesia	0.414	0.048-3.583	0.672
- GA			
- SB			
- BMI (kg/m^2)			
< 23.0	7.286	0.403-131.72	0.101
≥ 23.0	1.154	1.045-1.274	0.021*
- Preoperative anemia	0.745	0.166-3.351	0.730
- ASA Class 2 or higher	1.345	0.068-26.518	0.590
- Intraoperative blood loss (ml)	1.038	0.162-6.639	1.000

* Statistically significant

TAH: total abdominal hysterectomy, BSO: bilateral salpingo-oophorectomy, GA: general anesthesia, SB: spinal block, BMI: body mass index, ASA: American Society of Anesthesiologists

Discussion

In our study, we found that incidence of SSI was 9.76% which was similar to the reports by Taru et al5 and Young et al[6] (8.1% and 10.9%, respectively). Our study showed that the risk factor for SSI was BMI ≥ 23 kg/m^2 [18]. With regard to the SSI in our study, we found 8 superficial incisional SSI and no deep incisional and organ-space SSI, because all the patients in our

studies received prophylactic antibiotic by way of a single dose of cefazolin 1 gram intravenously before surgery. Prophylactic antibiotics decrease the bacterial inoculum burden on the skin and make the operative site less hospitable to the growth of bacteria. Furthermore, antibiotics concentrate in white blood cells resulting in enhanced phagocytosis of pathogenic bacteria. The antibiotic of choice for prophylaxis should have broad coverage. It should also be inexpensive and easy to administer. Cefazolin meets these criteria. Antibiotics should be administered within an hour of incision[4].

Why high BMI increased SSI, Justin et al[14] reported in 2012 that obese women have demonstrated altered immune cell function compared with those of a healthy weight. Due to discrepancies in leucocyte number and subset counts and phagocytic and oxidative burst activity of monocytes, additionally circulating mononuclear cells in obese exhibited a pro-inflammatory state and impaired lymphocyte proliferation to polyclonal stimulation. Type II diabetes, a common complication of obesity is associated with impaired immune cell activity. Individuals with a genetic mutation preventing proper synthesis of the hormone leptin, become morbidly obese and display weaken immune defenses. Interestingly obesity has been shown to enhance thymic aging and reduce T-cell repertoire diversity, thus possibly impacting immune surveillance. The reported findings of immune cell dysfunction suggest that may result in impaired host defense. Indeed, studies have linked obesity with increased risk of infection. Several reports have found obesity to be a significant risk factor for post-operative and surgical site, nosocomial, periodontal and respiratory infections[14].

Andersen et al[15] reported in 2016 that obesity was associated with metabolic disturbances that caused tissue stress and dysfunction. Obese individuals are at greater risk for chronic disease and often present with clinical parameters of metabolic syndrome (Mets), insulin resistance and systemic markers of chronic low-grade inflammation. It has been well established that cells of the immune system play an important role in the pathogenesis of obesity and Mets-related chronic diseases, as evidenced by leukocyte activation and dysfunction in metabolic tissue such as adipose tissue, liver, pancreas, and vasculature. However, recent findings have highlighted the substantial impact that obesity and Mets parameters have on immunity and pathogen defense, including the disruption of lymphoid tissue integrity; alterations in leukocyte development, phenotypes and activity; and the coordination of innate and adaptive immune responses. These changes are associated with and overall negative impact on chronic disease progression, immunity from infection, and vaccine efficacy.

Because SSI in gynecological surgery which represents a significant source of surgical morbidity and mortality and results in significant social and economic cost for patient and health care system[16]. Preventing surgical site infection in hysterectomy is essential.

Risk factors associated with SSI are both modifiable and unmodifiable. Unmodifiable risk factors include increasing age, a history of radiation exposure, vascular disease and history of prior SSIs. Modifiable risk factors include obesity, tobacco use, immunosuppressive medications, hypoalbuminemia, route of hysterectomy, hair removal, preoperative infections (such as bacterial vaginosis), surgical scrub skin and vaginal preparation, antimicrobial prophylaxis (inappropriate choice or timing, inadequate dosing or redosing), operative time, blood transfusion, surgical skill and operating room characteristics (ventilation, increase or traffic, and sterilization of surgical equipment)[17].

Although the specific measures vary between studies and a thorough SSI prevention bundle for benign gynecology recently published by the council on patient safety in women's healthcare. Research on SSI bundles indicates that implementation of several evidenced based strategies is likely to have a larger impact than pursuing any single intervention interventions clearly supported by the literature include timely administration of appropriately selected prophylactic antibiotics, we suggest a single dose of ß-lactam antibiotic, most commonly cefazolin 1 gram intravenously, and based on pharmacokinetic data on obese patients. We recommended increasing the dose of cefazolin to 2 grams in patient BMI ≥ 23.0 kg/m^2 for women who undergo an abdominal hysterectomy for

benign diseases to prevent SSI in the future. The use of a chlorhexidine alcohol base for skin preparation, use of suture for skin closure, and maintenance of glycemic control in postoperative procedure will help to decrease the occurrence of SSI in our patients.

Conclusion

In summary, an incidence of surgical site infection after abdominal hysterectomy in benign diseases in our study was 9.76% and BMI ≥ 23.0 kg/m^2 was a significant risk factor for SSI.

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Potential conflicts of interest

The author declares no conflict of interest.

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