ORIGINAL ARTICLE

SURGICAL SITE INFECTION AFTER LAPAROSCOPIC HYSTERECTOMY FOR BENIGN GYNECOLOGICAL DISEASE IN UKRAINE

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ABSTRACT

The aim: To obtain the first estimates of the current incidence, and risk factors for Surgical Site Infection (SSI) after laparoscopic hysterectomy, and antimicrobial resistance of responsible pathogens in Ukraine.

Materials and methods: We performed a multicenter prospective cohort study was patient-based on surveillance data for SSIs were according to CDC/NHSN methodology. This study included women's undergoing a laparoscopic hysterectomy in 8 hospitals from different regions of Ukraine from January 2018 to December 2020.

Results: A total of 1184 women underwent a laparoscopic hysterectomy and 14.9% SSI were identified within 30 days of the operation. Majority of SSI were deep/organ-space. The deep/organ-space SSI incidence rate was 9.2% in total laparoscopic hysterectomy, 15.2% in laparoscopic-assisted vaginal hysterectomy, and 17% in laparoscopic supracervical hysterectomy. The predominant SSI types were Pelvic abscess or cellulitis (19.1%), Salpingitis (16%), Oophoritis (15.3%), Adnexa utery (14.5%), Vaginal cuff infections (13.7%), Endometritis (11.1%), and Chorioamnionitis (9.9%). 93.8% of SSIs were detected post discharge. The most commonly identified pathogen were *Escherichia coli* (21.6%), *Enterobacter* spp. (13.1%), followed by *Klebsiella* spp. (8,1%), *Streptococcus* spp. (7%), and *Pseudomonas aeruginosa* (7%). The overall proportion of extended spectrum beta-lactamase production (ESBL) among Enterobacteriaceae was 17.1% and of methicillin-resistance in *S. aureus* (MRSA)15.8%. Resistance to third-generation cephalosporins was observed in 13.7% *E.coli* and 8.5% *Klebsiella* spp. isolates. Carbapenem resistance was in 9.7% of P.*aeruginosa* strains.

Conclusions: Our study identified high incidence rates of SSI within 30 days surveillance of the laparoscopic hysterectomy in Ukraine, and many cases were caused by pathogens that are resistant to antibiotics.

KEY WORDS: laparoscopic hysterectomy, benign gynecological disease, surgical site infection, risk factors, antimicrobial resistance

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INTRODUCTION

Hysterectomy is one of the most common surgical procedures in gynecology and includes the removal of the uterine corpus, the cervix, the removal of both fallopian tubes, and the removal of both ovaries. The hysterectomy procedure may be performed through an incision in the abdominal wall, by laparoscopy, or vaginally.

Hysterectomy incidence rates vary across countries. The estimated 433,000 hysterectomies done annually in the United States [1]. One is common procedure performed within the EU was hysterectomies. Hysterectomies were most frequently performed in 2018 in Czechia and Lithuania, while they were least common in Denmark. More than half of all hysterectomies in Finland, Estonia, Czechia, Poland and Belgium were performed laparoscopically. Between 2013 and 2018, the frequency of laparoscopic hysterectomies increased in 20 of the 21 Member States of EU for which data are available, the exception being Cyprus. Two Member States — Sweden and Croatia — reported the frequency of this procedure more than doubling during the period under consideration, while in Hungary it was more than four times as frequent in 2018 than it had been in 2013. [2].

Large increases reported for hysterectomies performed using laparoscopic techniques, which is a minimally invasive surgical procedure. A laparoscopic hysterectomy requires only a few small incisions, compared to a traditional abdominal hysterectomy. A laparoscopic hysterectomy is usually done as an outpatient procedure whereas an abdominal hysterectomy usually requires a 2-3 day hospital

stay. The recovery period for this laparoscopic procedure is 1-2 weeks, compared to 4-6 weeks after an abdominal hysterectomy.

According to literature, despite the introduction of minimally invasive procedures in the past decades [3, 4], hysterectomy is still associated with risk of surgical complications, including bleeding, infection [1, 5-7], and damage to the bladder and bowels [8, 9]. One of the most common complications after laparoscopic hysterectomy is Surgical Site Infection (SSI), the frequency of which varies from country to country [5-7]. SSIs occurring as a complication after laparoscopic hysterectomy for patients' pain and psychological stress, prolongs the hospital stay, and increases healthcare costs. The findings of previous studies have been inconsistent as to which causes increase the risk of surgical site infection after laparoscopic hysterectomy in gynecology. In Ukraine, similar studies have not been carried out.

THE AIM

The aim these study to obtain the first estimates of the current incidence rate, and risk factors for SSI after laparoscopic hysterectomy, and antimicrobial resistance of responsible pathogens in Ukraine.

MATERIALS AND METHODS

SETTING AND PARTICIPANTS

We performed a multicenter prospective cohort study was patient-based on surveillance data for SSIs were according to CDC/NHSN methodology. This study included women's undergoing a laparoscopic hysterectomy procedure in 8 hospitals from different regions of Ukraine from January 1st, 2018 to December 31st, 2020. All hospitals are similar in terms of medical equipment, staff and to have at least one full-time infection-control professional and clinical microbiology laboratory. Selection criteria: Only women's who underwent laparoscopic hysterectomy for benign gynecological disease were included. All patients were local residents. Patients highly suspicious of infection prior to the laparoscopic hysterectomy procedure were excluded. We excluded open abdominal hysterectomies. Patients that stayed in the hospital for less than 24 h post-operatively were not included in the study.

DEFINITIONS

In this study diagnosis of SSIs (superficial, deep, and organ space) after laparoscopic hysterectomy was based on criteria from the CDC/NHSN Surveillance Definitions for Specific Types of Infections [10]. An SSI had to occur within 30 days of the procedure and was classified as superficial or deep. A superficial SSI involved only skin and subcutaneous tissue of the incision. In this study, the term, deep SSI, refers to both deep and organ/space SSIs. They were combined because the fascia and muscle layers of the vaginal cuff are contiguous with the hysterectomy organ space. Laparoscopic hysterectomy has three further subdivisions - laparoscopic assisted vaginal hysterectomy (LAVH) where a vaginal hysterectomy is assisted by laparoscopic procedures that do not include uterine artery ligation, laparoscopic hysterectomy (which we will abbreviate to LH(a)) where the laparoscopic procedures include uterine artery ligation, and total laparoscopic hysterectomy (TLH) where there is no vaginal component and the vaginal vault is sutured laparoscopically. An in-patient is a patient who is formally admitted (or 'hospitalised') to an institution for treatment and/or care and stays for a minimum of one night or more than 24 hours in the hospital or other institution providing in-patient care [11].

DATA COLLECTION

The surveillance period for the patients was 30 days. We analyzed the inpatient data and ambulatory medical records to identify SSIs after laparoscopic hysterectomy procedures. Data were collected using predefined data collection forms developed after literature review to identify risk factors for SSI and also after local expert group consultations. Trained nurses collected information daily on all study participants after obtaining informed written consent, and followed them until discharge, completed a form containing potential risk factors for SSI. The in-charge teaching faculty, junior and senior resident, did direct surgical site surveillance by inspecting the surgical site 48 to 72 h after surgery. The post discharge surveillance was performed upon return to hospital and during visits to ambulatory. A systematic literature review with pooled analysis was performed to explore differences in SSI incidence rate and risk factors.

MICROBIOLOGICAL METHODS

In this study all samples were obtained from women with clinical symptoms of SSI. Microbial isolates were identified using standard microbiological techniques. Antibiotic susceptibility testing was performed by using the disk diffusion method according to the recommendations of the EUCAST. All strains in the intermediate range were classified as resistant to antibiotics for data analysis.

ETHICS

Ethical permission for the study was obtained from the Ethics Committee of Shupyk National Healthcare University of Ukraine. Informational consent was obtained from the study participants. Participants data were anonymised prior to the analysis.

STATISTICAL ANALYSIS

All cases from sites contributing at least 100 laparoscopic hysterectomies were included in the analysis. Frequencies and percentages were determined for binary and categorical

Table I. Incidence rate of SSI after laparoscopic hysterectomy types in Ukrainian hospitals (2018-2020)

Types of laparoscopic procedures	Number of patients	SSI n/%	Incidence of SSI 95% CI
All	1184	177(14.9)	13.9 – 15.9
Total laparoscopic hysterectomy	207	19(9.2)	7.2 – 11.2
Laparoscopic-assisted vaginal hysterectomy	466	71(15.2)	13.5 – 16.9
Laparoscopic supracervical hysterectomy	511	87(17.0)	15.3 – 18.7

Table II. Distribution of SSI types - associated laparoscopic hysterectomy in Ukrainian hospitals, 2018-2020 ($P < 0.05$)

SSI Types	Number of patients with SSI	SSI %	95% CI
All	177	100	
A pelvic abscess or cellulitis	25	19.1	16.7 – 21.5
Adnexa utery	19	14.5	12.4 – 16.6
Salpingitis	21	16.0	13.8 – 18.2
Oophoritis	20	15.3	13.2 – 17.4
Endometritis	15	11.5	9.8 – 13.2
Chorioamnionitis	13	9.9	8.3 – 11.5
Vaginal cuff infections	18	13.7	11.7 – 15.7

SSIs, Surgical Site Infections; CI, confidence interval;

variables. Range and means were calculated for continuous variables. Overall and procedure specific cumulative incidence rate of SSI was also calculated. Demographics, medical history, and complications were analyzed. Univariate and multivariable analyses were performed for 13 risk factors potentially related to post-operative SSI, including age, obesity, parity, vaginal examinations 48 h. before surgery, vaginal discharge, medical comorbidities, diabetes mellitus, American Society of Anesthesiologists (ASA) score, and type of surgery, type of anesthesia, duration of surgery, antibiotic prophylaxis, and surgeon's experience. Univariate analyses to examine the association with SSI were performed using the t test or Wilcoxon rank sum test as appropriate for continuous variables and the chi-square test or Fisher's exact test as appropriate for categoric variables. Significant variables on univariate analysis were included in a stepwise, backward multivariable logistic regression to identify the independent risk factors of SSI. Variables were excluded from model selection if not significant or not related in a clinically plausible manner. A $p < 0.05$ was considered statistically significant.

RESULTS

INCIDENCE OF SSI

A total of 1184 patients underwent a laparoscopic hysterectomy procedure during the study period (2018-2020). The overall SSI rate following all type of laparoscopic hysterectomy was 14.9% (177 of 1184). The incidence rate of SSI after total laparoscopic hysterectomy (TLH) was 9.2% (19/207), SSI after laparoscopic-assisted vaginal hysterectomy (LAVH) was 15.2% (71/466), and the rate of SSI after laparoscopic supracervical hysterectomy (LSCH) was 17% (87/511) (Table I).

Of all detected cases of SSI, 26% (46/177) were superficial SSI and 74% (131/177) were of deep SSI or organ space SSI. The distribution of specific types deep SSI or organ space SSI - associated laparoscopic hysterectomy in Ukrainian hospitals are presented in Table II. Of these deep or organ space SSI cases, 19.1% (95% CI 16.7 – 21.5) Pelvic abscess or cellulitis, 16% (95% CI 13.8 – 18.2) Salpingitis, 15.3% (95% CI 13.2 – 17.4) Oophoritis, 14.5% (95% CI 12.4 – 16.6) Adnexa utery, 13.7% (95% CI 11.7 – 15.7) Vaginal cuff infections, 11.1% (95% CI 9.8 – 13.2) Endometritis, and 9.9% (95% CI 8.3 – 11.5) Chorioamnionitis were identified (Table II). Of all cases 6.2% (11/177) of SSIs after laparoscopic hysterectomy were detected in during the admission period and 93.8% (166/177) were detected post discharge.

ANTIBIOTIC PROPHYLAXIS

In Ukraine antibiotic prophylaxis at gynecological surgery procedure is standard practice. In the present study 45.8% (542/1184) women who underwent laparoscopic hysterectomy for benign gynecological disease were given antimicrobial prophylaxis. The incidence of SSI among women who did not receive antibiotic prophylaxis was 21.7%. (Table III). Women who received antibiotic prophylaxis had fewer SSI after laparoscopic hysterectomy (7% vs. 21.7%). In this study the most hospitals (58.3%) the first choice of antibiotic agent for prophylaxis was cefazoline or cefotaxim. Other hospitals used Amoxicillin clavulanate (Augmentin).

RISK FACTORS

In present study there were no statistically significant differences between patients having superficial versus patients

Table III. Demographic, perioperative, and intraoperative characteristics of women with and without surgical site infection after laparoscopic hysterectomy in Ukraine (2018-2020)

Variables	Number of patients (n=1184)	SSI		Odds Ratio (OR)	95% CI of OR	P value
		No (n=1087) n/%	Yes (n=177) n/%			
Age, yrs						
	312	285(91.3)	27(8.7)	R	-	-
26-45	471	403(85.6)	68(14.4)	2.17	1.12–4.26	0.021
≥46	401	319(79.6)	82(20.4)	2.93	1.52–5.71	0.001
Parity						
Primiparous	152	140(92.1)	12(17.9)	R	-	-
Multiparous	187	171(91.4)	16(8.6)	2.93	0.60–14.3	0.184
Grand-multiparous	54	46(85.2)	8(14.8)	7.27	0.25–32.7	0.396
Non pregnant	791	650(82.2)	141(18.8)	8.90	2.16–36.58	0.002
Obesity						
Body mass index ≤ 30 kg/m	1072	944(88.6)	128(11.4)	R	-	-
Body mass index ≥ 30 kg/m	112	63(56.3)	49(43.7)	7.51	4.01–14.91	<0.005
Vaginal examinations 48 h. before surgery, No						
None	669	613(91.6)	56(8.4)	R	-	-
1–5	428	363(84.8)	65(15.2)	2.34	1.43–3.82	0.001
>5	87	31(35.6)	56(64.4)	7.51	4.07–13.84	<0.005
Vaginal discharge						
No	1094	958(87.6)	136 (12.4)	R		
Yes	90	49(54.4)	41(45.6)	5.46	3.35–8.88	<0.005
Diabetes mellitus						
No	1085	956(88.1)	129 (11.9)	R	-	-
Yes	99	51(51.5)	48(48.5)	7.86	4.7–13.12	<0.005
Medical comorbidities						
No	953	874(91.7)	79(8.3)	R	-	-
Yes	231	133(57.6)	98(42.4)	11.55	7.24–18.42	<0.005
ASA Physical Status class						
1-2	1121	988(88.1)	133(11.9)	R	-	-
≥ 3	63	19(30.2)	44(69.8)	20.26	11.54–35.6	<0.005
Emergency surgery						
No	895	802(89.6)	93(10.4)	R	-	-
Yes	289	205(70.9)	84(29.1)	2.54	1.64–3.93	<0.005
Type of anesthesia						
Local or spinal	899	811(90.2)	88(9.8)	R	-	-
General	285	196(68.8)	89(31.2)	2.91	1.88–4.49	<0.005
Duration of surgery, min						
60-90	288	263(91.2)	25(8,8)	R	-	-
91-120	853	726(85.1)	127(14.9)	1.72	0.91–3.23	0.92
>121	43	18(41.9)	25(58.1)	5.61	5.08–28.39	<0.005
Antibiotic prophylaxis						
Yes	542	504 (93.0)	38(7.0)	R	-	-
No	642	503(78.3)	139(21.7)	5.92	3.18–11.00	<0.005
Surgeon's experience, yrs						
1 or 2	1043	931(89.3)	112(10.7)	R	-	-
3 - 5	141	76(53.9)	65(46.1)	3.78	2.32–6.14	<0.005

SSIs, Surgical Site Infections; CI, confidence interval; ASA, American Society of Anesthesiologists'

having deep SSI after laparoscopic hysterectomy, therefore the risk factor for both are presented together. Patients older than 46 years of age were more likely to have an SSI after laparoscopic hysterectomy than those between 25 and 46 year of age (OR 2.93; vs. 2.17); as compared to those less than 25 years of age. The odds of SSI after laparoscopic hys-

Table IV. Distribution of responsible pathogens (n=541) of SSI after laparoscopic hysterectomy in Ukrainian hospitals (2018-2020)

Micro-organisms	Total of isolates		Types of laparoscopic hysterectomy			
			abdominal		vaginal	
	n	%	n	%	n	%
Gram-positive cocci	148	27.4	98	66.2	50	33.8
Staphylococcus aureus	34	6.3	30	88.2	4	11.8
CoNS[a]	29	5.4	27	93.1	2	6.9
Streptococcus spp.	38	7.0	14	36.8	24	63.3
Enterococcus faecalis	35	6.5	19	54.3	16	45.7
Enterococcus faecium	12	2.2	8	66.7	4	33.3
Gram-negative bacilli	371	68.6	132	35.6	239	64.4
Escherichia coli	117	21.6	43	36.8	74	63.2
Enterobacter spp.	71	13.1	24	33.8	47	66.2
Klebsiella spp.	44	8.1	8	18.2	36	81.8
Pseudomonas aeruginosa	38	7.0	23	60.5	15	39.5
Proteus mirabilis	34	6.3	1	2.9	33	97.1
Citrobacter spp.	25	4.6	16	64.0	9	36.0
Serratia spp.	23	4.3	11	47.8	12	52.2
Stenotrophomonas maltophilia	19	3.5	6	31.6	13	68.4
Fungi	22	4.1	0	0	22	100
Candida albicans	19	3.5	0	0	19	100
Other fungi	3	0.6	0	0	3	100
Total of isolates	541	100	230	42.5	311	57.5

Note aCoNS, coagulase-negative staphylococci

terectomy were almost 3-4 times higher for non pregnant and grand-multipara (5 or more pregnancies) compared to primiparous women. Presence of bacterial vaginosis before the laparoscopic hysterectomy increased the risk of SSI. Presence of Diabetes mellitus and medical comorbidities, emergency surgery and use of general anesthesia during the surgery increased the risk of SSI (Table III). ASA physical status class 3 or higher had greater risk for SSI compared with class 1 or 2 (OR 20.26). Duration of surgery procedure of more than 2 h increased risk of SSI (OR 5.61), and also no antibiotic prophylaxis was associated with increased risk of SSI (Table III). A surgeon's experience of less than 3 years increases the risk of SSIs after laparoscopic hysterectomy compared with 3 or more years of experience (Table III).

MICRO-ORGANISMS CAUSING SSI AND ANTIMICROBIAL RESISTANCE

A total of 541 specimens isolated from 177 patients with SSI. Gram-positive organisms accounted for 27.4% (148/541) of all isolates and gram-negative organisms accounted 68.6% (371/541), and 4.1% (22/541) respectively. The most commonly identified pathogen were *Escherichia coli* (21.6%), *Enterobacter* spp. (13.1%), *Klebsiella* spp. (8,1%), *Streptococcus* spp. (7%), and Pseudomonas aeruginosa (7%), followed by *Enterococcus faecalis* (6,5%), *Staphylococcus aureus* (6,3%), and *Proteus mirabilis* (6,3%). Enterobacteriaceae were the most frequently isolated group of organisms (Table IV).

In this study the overall proportion of extended spectrum beta-lactamase (ESBL) production among Enterobacteriaceae was 17.1% and of methicillin-resistance in *S. aureus* (MRSA) 15.8%. Resistance to third-generation cephalosporins was observed in 13.7% *E.coli* and 8.5% *Klebsiella* spp. isolates. Carbapenem resistance was identified in 9.7% of *P.aeruginosa* isolates.

DISCUSSION

To the best of our knowledge this is the first study in Ukraine reporting incidence and risk factors for SSI after laparoscopic hysterectomy for benign gynecological disease, and antimicrobial resistance of responsible pathogens. A total of 1184 women underwent a laparoscopic hysterectomy procedure during the study period and 14.9% SSI were identified within 30 days of the operation. Majority (74%) of SSI were deep/organ-space. The deep/organ-space SSI incidence rate was 9.2% in TLH, 15.2% in LAVH, and 17% in LSCH. The predominant SSI types after laparoscopic hysterectomy were Pelvic abscess or cellulitis (19.1%), Salpingitis (16%), Oophoritis (15.3%), Adnexa utery (14.5%), Vaginal cuff infections (13.7%), Endometritis (11.1%), and Chorioamnionitis (9.9%). Of these, 93.8% cases of SSIs were detected post discharge.

According literature data, SSI is a common complication of hysterectomy. Minimally invasive hysterectomy has lower infection rates than abdominal hysterectomy [12]. The incidence of SSI rate in laparoscopic hysterectomy is was 1.6-4% [1, 6, 12, 13]. The SSI rates after laparoscopic hysterectomy were reported to be as high as 9% in one series of more than 10,000 cases, despite the advances in aseptic technique, antibiotic prophylaxis, and technology - hence, the need to discuss preventive methods and strategies [14]. The overall rate of 30-day deep or organ-space SSI was 1.8% [5]. Thirty-day deep or organ-space SSI was lower in women who underwent LSCH (0.6%) than in women who underwent TLH (1.0%) or LAVH (1.1%) [5]. Another study showed that SSI rates were 0.5-0.6% in TLH [15]. The incidence rate of SSI in laparoscopic hysterectomy procedures in the Ukraine were significantly higher than those reported from other countries [1, 5, 6, 12-15]. Possibly this is due to the use of various surveillance methods for SSI in laparoscopic hysterectomy. Surveillance of SSI, whether active or passive, can differ across institutions and country. We used of CDC/NHSN methodology based on the SSI surveillance period is 30 days after operation.

Reducing SSI rate in laparoscopic hysterectomy is one of the more effective ways of improving patient safety. Knowledge and understanding of risk factors for infection following laparoscopic hysterectomy enable the gynecologic surgeon or hospital to implement targeted preventive measures [12]. Our study has shown that age ≥46, obesity, vaginal examinations 48 h. before surgery >5, bacterial vaginosis, medical comorbidities, diabetes mellitus, ASA score ≥ 3, and emergency type surgery, general type of anesthesia, duration of surgery >121 min., no antibiotic prophylaxis, and surgeon's experience 2 ≤ yrs. are associated with the highest risk of SSI after laparoscopic hysterectomy.

In the present study, the most frequently identified causing pathogens of SSIs following laparoscopic hysterectomy for benign gynecological disease were *E. coli, Enterobacter* spp., *Klebsiella* spp., *Streptococcus* spp., and *P. aeruginosa*, followed by *E. faecalis*, *S. aureus*, and *P. mirabilis.* Other pathogens included CoNS, *Citrobacter* spp., *Serratia* spp., *Stenotrophomonas maltophilia, E.faecium,* and *C. albicans.* According to literature, the source of pathogens for trocar-related infection is predominantly aerobic Gram-positive cocci originating from the endogenous flora of the patient's skin [12]. Frequently encountered organisms are *S. aureus*, CoNS, *Enterococcus* spp., and *E. coli* [16]. However, hysterectomies are unique from other abdominal and gynecologic procedures, in that potential pathogenic microorganisms may ascend from the breached vagina and endocervix to the operative site, in addition to the microorganisms from the skin [12]. Therefore, gynecologic SSIs are usually polymicrobial [7, 17, 18].

Antibiotic prophylaxis is a reasonable option in women undergoing laparoscopically assisted hysterectomy, although no evidence is available to support this use. According to literature, antimicrobial prophylaxis is one of the positive steps that reduce SSI [19]. In results the use of prophylactic antibiotics only 7% of our patients after laparoscopic hysterectomy developed SSI. Antibiotic prophylaxis for hysterectomy has been extensively studied, and it has been estimated that such prophylaxis has reduced the rate of postoperative SSI by more than half; otherwise, about 40% to 50% of women would develop infection after vaginal hysterectomy and more than 20% after abdominal hysterectomy [16, 19]. The most National guidelines now recommend this practice for all types of hysterectomy [19, 21-24], although in reality, application of such guidelines is variable.

Use of antibiotics is effective for infection prophylaxis, but this benefit must be weighed against the risk for selection of antibiotic-resistant bacteria. In our study the overall proportion of extended spectrum beta-lactamase (ESBL) production among Enterobacteriaceae was 17.1% and of methicillin-resistance in *S. aureus* (MRSA) 15.8%. Resistance to third-generation cephalosporins was observed in 13.7% *E.coli* and 8.5% *Klebsiella* spp. isolates. Carbapenem resistance was identified in 9.7% of *P.aeruginosa* isolates. In literature, evidence was insufficient to show which individual antibiotic is most effective. Antimicrobial resistance of SSI pathogens varies from country to country and even from hospital to hospital. Therefore, the findings our study may not reflect current practice in perioperative and postoperative care and may not show locoregional antimicrobial resistance patterns other country. However, our research provides valuable data for comparing antimicrobial resistance in Ukraine and other countries. More studies including large numbers of women who underwent laparoscopic hysterectomy for benign gynecological disease and based on sound methods are needed to detect meaningful differences in efficacy between various antibiotics. Also needed are more studies investigating various antibiotics in different combinations, dose regimens, and routes of administration to determine which combinations, dose regimens, and routes of administration are associated with better efficacy and fewer adverse effects. Laparoscopic hysterectomy is now commonly performed; thus future research should focus on the use of prophylaxis in laparoscopic hysterectomy (total or subtotal laparoscopic hysterectomy or laparoscopically assisted vaginal hysterectomy).

STRENGTHS AND LIMITATION

The present a multicenter prospective cohort study was patient-based on surveillance data is the first step in Ukraine reporting incidence and risk factors for SSI following laparoscopic hysterectomy for benign gynecological disease. The strengths of our study lie in the application of CDC/NHSN methodology based on the standard SSI criteria and where the surveillance period is 30 days after operation. Majority (93.8%) of SSI were detected post discharge. This knowledge is essential to develop targeted strategies to surveillance and reduce the incidence of SSI in laparoscopic hysterectomy. The present study provides valuable data for comparison with data from other countries. A limitation of the study is that it only includes 1184 women's undergo-

ing a laparoscopic hysterectomy procedure in 8 hospitals. Therefore, the results this study may not be representative of other hospitals of Ukraine with different distributions of incidence rate of SSI in laparoscopic hysterectomy procedures and antimicrobial resistance of causing pathogens. Further research is required to determine which set of interventions optimize prevention of SSI in laparoscopic hysterectomy, and improvement in patient outcomes.

CONCLUSIONS

Our study identified high incidence rates of SSI within 30 days surveillance after laparoscopic hysterectomy for benign gynecological disease in Ukraine, and many cases were caused by pathogens that are resistant to antibiotics. Majority of SSI were detected post discharge. Results the present study suggest that the prevention and treatment of SSI associated with laparoscopic hysterectomy in Ukraine needs to be changed. Antibiotic prophylaxis is a reasonable option in women undergoing laparoscopically assisted hysterectomy, although no evidence is available to support this use. The data in Ukraine are limited and more studies are needed. Further research is required to define the role of the newer infection control approaches to laparoscopic hysterectomy procedures in gynecology. The results of present study provide valuable data as a first study in Ukraine for surveillance of SSI in laparoscopic hysterectomy and potential for comparison with data from other countries.

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