ORIGINAL ARTICLE

EPISIOTOMY INFECTIONS IN THE PUERPERIUM AND ANTIMICROBIAL RESISTANCE OF RESPONSIBLE PATHOGENS IN UKRAINE

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ABSTRACT

The aim: To obtain the first estimates of the current prevalence rate of episiotomy infections in the puerperium and antimicrobial resistance of responsible pathogens in Ukraine.

Materials and methods: We performed a retrospective multicenter cohort study was based on surveillance data. The study population consisted of all women who had a vaginal delivery in 7 Regional Women's Hospitals of Ukraine. Definitions of episiotomy infections were used from the Centers for Disease Control and Prevention's National Healthcare Safety Network (CDC/NHSN).

Results: Total 35.6% women after vaginal delivery had episiotomy done. The prevalence rate of episiotomy infections was 17.7%. The predominant pathogens were: *Escherichia coli* (49.2%), *Enterobacter* spp. (11.1%), *Streptococcus* spp. (9.1%), *Enterococcus faecalis* (6.5%), *Klebsiella* spp. (8.1%), followed by *Pseudomonas aeruginosa* (4.7%), *Staphylococcus aureus* (4.2%), *Proteus* spp.(2.9%) and *Staphylococcus epidermidis* (2.8%). The overall proportion of methicillin-resistance was observed in 17.3% of *Staphylococcus aureus* (MRSA). Vancomycin resistance was observed in 6.8% of isolated enterococci. Carbapenem resistance was identified in 8% of *P.aeruginosa* isolates. Resistance to third-generation cephalosporins was observed in 15.2% *Klebsiella* spp. and *E.coli* 16.4% isolates. The overall proportion of extended spectrum beta-lactamases (ESBL) production among Enterobacteriaceae was 26.4%. The prevalence of ESBL production among *E. coli* isolates was significantly higher than in *K. pneumoniae* (31.4%, vs 12.5%).

Conclusions: Episiotomy infections in the puerperium are common in Ukraine and most of these infections caused by antibiotic-resistant bacteria. Optimizing the management and empirical antimicrobial therapy may reduce the burden of episiotomy infections, but prevention is the key element.

KEY WORDS: Episiotomy, vaginal delivery, antimicrobial resistance, pathogens

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INTRODUCTION

Episiotomy infections in the puerperal period can pose a significant risk of morbidity to women. These infections interrupt postpartum restoration; increase the potential for readmission to a health care facility. In addition, unrecognized or improperly treated genital tract infection could extend to other sites and increase the risk of severe complications or sepsis [1]. Despite the widespread application of standard aseptic techniques during vaginal birth, post-pregnancy infections remain a significant source of maternal morbidity.

In literature, episiotomy infections are reported as being rare at a rate [2]. However, the true incidence of bacterial infections in the puerperium is not fully understood as outpatient surveillance data are lacking. The most study have documented endometritis, mastitis, urinary tract infections (UTIs), and episiotomy infections at higher rates than reported by hospital surveillance systems [3-6].

Current guidelines for the treatment of infections recommend the immediate prescription of antimicrobial medicines as soon as the infection is diagnosed. Broad spectrum antimicrobials should be prescribed even before the culture results are known in order to cure the most probable infection agents [7]. Targeted antibacterial treatment should be provided following the identification of an etiological agent and resistance status. However, the results of numerous investigations prove that the prescription of an inadequate starting therapy raises the mortality rate among patients with severe infections by 1.5 – 3 times [8, 9]. In addition, inadequate therapy extends the duration of hospitalization and provokes a need for additional courses of antimicrobial therapy that makes treatment more expensive. Literature data on the etiology and resistance of pathogens caused postpartum infections varies considerably [3, 4, 6].

The epidemiology of postpartum infections in Ukraine and associated treatment outcomes are not well studied. National network for the surveillance of antimicrobial resistance is not in Ukraine [10, 11]. Previous reports of postpartum infection in Ukraine were limited [3,4].

THE AIM

The aim of this study was to obtain the first estimates of the current prevalence rate of episiotomy infections in the puerperium and antimicrobial resistance of responsible pathogens in Ukraine

MATERIALS AND METHODS

STUDY DESIGN AND SETTING

A retrospective cohort study was based on surveillance data for episiotomy infections in the puerperium and included all women's who had undergone vaginal delivery at the 7 (tertiary) Regional Women's Hospitals of Ukraine. The study was conducted between January 1st, 2017 and December 31st, 2019. These hospitals provide care to individuals living within its catchment area (total 2 132 450 women's) and regularly take referrals from other (secondary) hospitals. We have included women's hospitals that are similar in terms of medical equipment, personnel, and laboratory facilities. The hospitals had 525 beds. All participating hospitals were required to have at least one full-time infection-control professional, a clinical microbiology laboratory with the capacity to process cultures.

DEFINITION

In our study the CDC/NHSN (Centers for Disease Control and Prevention/National Healthcare Safety Network, Atlanta, Georgia, USA) definition [12] of episiotomy infections was used. Episiotomy infections must meet at least 1 of the following criteria: (1) postvaginal delivery patient has purulent drain age from the episiotomy or (2) postvaginal delivery patient has an episiotomy abscess. Episiotomy is not considered an operative procedure in NHSN.

DATA COLLECTION

The inclusion criterion was having had an assisted vaginal delivery at Regional Women's Hospitals. Women who had been submitted to episiotomy were considered cases, while those who had not undergone episiotomy were admitted as controls. In this study, we analyzed the inpatient data and ambulatory medical records to identify episiotomy infections and describe the epidemiology of these infections. A standard data collection form was created to extract demographic and clinical data, microbiology (isolated pathogens and their antibiograms) and outcome information from inpatient data and ambulatory medical records. We collected the data using structured questionnaires adapted from based on the definition used by CDC/NHSN on episiotomy infections. The follow-up of each patient was in hospitalization period and continued during 10 days after discharge.

MICROBIOLOGICAL SAMPLING AND SUSCEPTIBILITY TESTING

Samples were taken from women which clinical episiotomy infections. Microbial isolates were identified using standard microbiological techniques, including automated microbiology testing (Vitek-2; bioMe´rieux, Marcy l'Etoile, France), and antibiotic susceptibility testing was performed by using the disk diffusion method (Kirby – Bauer antibiotic testing) according to the recommendations of the Clinical and Laboratory Standards Institute (CLSI). Strains showing inhibition zone diameters in the intermediate range were considered resistant.

ETHICS

The Shupyk National Medical Academy of Postgraduate Education (Kyiv, Ukraine) ethics committee approved this study. All the women voluntarily agreed to participate in the study and signed an informed consent form. All patient data were anonymised prior to the analysis. Ethical considerations including privacy of personal data were considered during all steps of the research.

STATISTICAL ANALYSIS

The incidence of episiotomy infections was reported as the percentage of the total number of vaginal delivery patients who had an episiotomy procedure. The analysis of statistical data was performed using Excel (Microsoft Corp., Redmond, WA, USA). Results are expressed as median (range), mean standard deviation for continuous variables, and number and corresponding percentage for qualitative variables. Comparisons were undertaken using Student's t-test and Fisher's exact test for categorical variables. Statistical significance was defined as $P<0.05$.

RESULTS

EPISIOTOMY INFECTIONS AND PATIENT CHARACTERISTICS

During the study period a total of 25854 participants had vaginal deliveries were included in the analysis. The prevalence of episiotomy procedures was 35.6 % (9,213/25854). In this study recruited both primiparous and women of higher parity. The rate of episiotomy procedure was determined as 73.1% in primipara women and as 24.7% in multipara women. The incidence of episiotomy infections was 17.7% [95% CI 16.8%, 18.7%]. Of the total cases episiotomy infections, 74.8% (6,847/1,628) were detected after hospital discharge. For these post-discharge infections, 68.7% of patients did not return to the hospital where they delivered for evaluation or treatment. The participants were aged between 16 and 32 years, with a mean age of 20.9 years and a standard deviation of (SD) 2.9. The majority of the study participants with episiotomy infections 1469 (18.6%) were married and had attained secondary school education 1470 (41.3%). More than half of the participants were housewives 1295 (20.8%). Characteristics of patients with episiotomy infections are shown in Table I.

ANTIBIOTIC PROPHYLAXIS

Of 9213 participants who underwent chart review, 8278 (89.9%) were prescribed combination ceftriaxone and metronidazole postpartum, though there was little documentation of antibiotic receipt. Ceftriaxone and metronidazole was also prescribed for 1234/1628 (75.8%)

Table I. Characteristics of patients with episiotomy infections in Ukraine

Characteristics	Total cohort (n=9,213)	Episiotomy infections (n=1,628)		Incidence of episiotomy infections [95% CI[a]]
		n	%	
Age (years, mean, SD[b])	20.9	17.1		
Age category[c]				
≤16	148	18	12.2	9.5 – 14.9
17- 21	4,894	844	17.2	16.7 – 17.7
22 - 26	3,168	488	15.4	14.8 – 16.0
27-31	760	211	27.8	25.6 – 29.4
≥ 32	243	67	27.6	24.7 – 30.5
Gestational Age (weeks)				
<37	388	37	9.5	7.1 – 11.9
≥37	8825	1,591	18.0	17.0 – 19.0
Marital status				
Married	7,879	1,469	18.6	17.6 – 19.6
Single	1,186	146	12.3	11.4 – 13.3
Separated/Divorced	148	11	7.4	5.3 – 9.9
Education level				
Secondary	3,563	1470	41.3	40.0 – 42.6
College/University	987	158	16.0	14.8 – 17.2
Occupation				
Housewife	6,214	1,295	20.8	20.3 – 21.3
Employed	2,555	316	12.4	11.8 – 13.1
Business	444	17	3.8	2.9 – 4.7
Total	9,213	1,628	17.7	16.8 – 18.7

Note: a – Confidence interval. b – Standard deviation.

Table II. Distribution of pathogens, isolated from episiotomy wound secretion samples.

Microorganism	Frequency (n=2893)	Percentage (%)
Gram-positive cocci	653	22.6
S. aureus	122	4.2
S. epidermidis	82	2.8
Streptococcus spp.	261	9.1
E. faecalis	188	6.5
Gram-negative bacilli	2219	76.7
E. coli	1423	49.2
Enterobacter spp.	322	11.1
Klebsiella spp.	255	8.1
Proteus spp.	83	2.9
P. aeruginosa	136	4.7
Fungi	21	0.7
Candida albicans	18	0.6
Other	3	0.1

participants meeting criteria for episiotomy infections. Another 227/1628 (13.9%) had no antibiotic prescription, and 167/1628 (10.3%) were prescribed alternative antibiotic regimens. Overall, 89,9% participants had a chart-documented prescription for β-lactam antibiotic prophylaxis, including 75,8% of participants with episiotomy infection.

PATHOGENS CAUSING OF EPISIOTOMY INFECTIONS

A total of 2893 different bacterial strains were isolated from 1628 women's with episiotomy infections. In the present study, 6.2% samples did not show any microbial growth. It is possible that the media/conditions used in the study were not favourable for the growth of microorganisms present in these samples. Aerobic gram-negative bacilli make up 76.7% and 22.6% gram-positive cocci from of all isolates. The predominant pathogens were: *Escherichia coli* (49.2%), *Enterobacter* spp. (11.1%), *Streptococcus* spp. (9.1%), *Enterococcus faecalis* (6.5%), *Klebsiella* spp. (8.1%), followed by *Pseudomonas aeruginosa* (4.7%), *Staphylococcus aureus* (4.2%), *Proteus* spp. (2.9%) and *Staphylococcus epidermidis* (2.8%). The distribution of the microorganisms causing of episiotony infection are shown in Table II.

ANTIMICROBIAL RESISTANCE OF RESPONSIBLE PATHOGENS

Antimicrobial susceptibility tests were performed on a total of 653 isolates of Gram-positive cocci and 2219 gram-negative organisms. The antimicrobials used in antimicrobial susceptibility testing included those commonly used as therapeutic agents. Varying degrees of resistance to most antimicrobials tested were found. The antibiotic susceptibility profiles of isolates from women's with episiotomy infections are presented in Table III and Table IV.

The overall proportion of methicillin-resistance was observed in 17.3% of *Staphylococcus aureus* (MRSA). Vancomycin resistance was observed in 6.8% of isolated enterococci (VRE). Carbapenem resistance was identified in 8% of *P.aeruginosa* isolates. Resistance to third-generation cephalosporins was observed in 15.2% *Klebsiella* spp. and *E.coli* 16.4% isolates. The overall proportion of extended spectrum beta-lactamases (ESBL) production among Enterobacteriaceae was 26.4%. The prevalence of ESBL production among *E. coli* isolates was significantly higher than in *K. pneumoniae* (31.4%, vs 12.5%).

DISCUSSION

This is the first study were to obtain of the current prevalence rate of episiotomy infections in the puerperium and antimicrobial resistance of responsible pathogens in Ukraine.

Episiotomy is one of the most frequent surgical interventions performed in obstetrics. One reason for episiotomy is perineal protection from severe lacerations. Prevalence of episiotomy varies significantly between countries. The primiparity has been seen in many studies as an important risk factor for episiotomy. The rate of episiotomy varies between 9.7% and 100% in both primipara and multipara women [13-18]. In our study, the prevalence of episiotomy was 35.6%.

Episiotomy is obstetric procedure, due to its special anatomy position, carelessness treatment can lead to incision infection, which is mainly related to its susceptibility to vaginal, intestinal and urethral microbial flora infection. Currently routine episiotomy is no longer performed, however infections still occur and are often seen post-vaginal or operative vaginal delivery. According to the literature data, the episiotomy infection rate was from 0.3% to 10.42% [19]. In our study prevalence of episiotomy infection rate was 17.7%.

According to the literature data, pathogens of episiotomy infections are gram-negative bacilli and gram-positive cocci. Previous studies have shown that the episiotomy infection pathogen bacteria of infection were mainly gram negative bacteria [20]. In our study the pathogen bacteria of infection were also mainly gram negative bacteria. The predominant pathogens were: *Escherichia coli* (49.2%), *Enterobacter* spp. (11.1%), *Streptococcus* spp. (9.1%), *Enterococcus faecalis* (6.5%), *Klebsiella* spp. (8.1%), followed by *Pseudomonas aeruginosa* (4.7%), *Staphylococcus aureus* (4.2%), *Proteus* spp.(2.9%) and *Staphylococcus epidermidis* (2.8%).

In this study the overall proportion of MRSA was observed in 17.3% and of VRE in 6.8%. Carbapenem resistance was identified in 8% of *P.aeruginosa* isolates. Resistance to third-generation cephalosporins was observed in 15.2% *Klebsiella* spp. and *E.coli* 16.4% isolates. The overall proportion of ESBL production among Enterobacteriaceae was 26.4%. The prevalence of ESBL production among *E. coli* isolates was significantly higher than in *K. pneumoniae*.

Bacterial infections occurring during labour, childbirth, and the puerperium may be associated with considerable maternal morbidity. Antibiotic prophylaxis might reduce wound infection incidence after an episiotomy, particularly in situations associated with a higher risk of postpartum perineal infection [21]. However, available evidence is unclear concerning the role of prophylactic antibiotics in preventing infections after an episiotomy. In our study, it was observed that prophylactic antibiotics had little effect on infection cases in episiotomy following normal vaginal delivery, but further studies is needed come to a more definitive conclusion.

Antibiotic prophylaxis is one of the methods to reduce the risk of post-partum infections. The purpose of antibiotic prophylaxis is to reduce the colonisation pressure of microorganisms introduced at the time of operation to a level that the patient's immune system is able to overcome [22]. Routine antibiotic prophylaxis is not recommended after an episiotomy or repair of an obstetric laceration [22]. However, infection increases the risk of perineal repair breakdown, particularly for higher-order (third- or fourth-degree) lacerations [23]. General infection control measures, such as hand hygiene, aseptic surgical techniques, disinfection of the surgical site, and sterilisation of instruments can help minimise the risk of episiotomy infection [24]. Because puerperal genital tract infection usually begins after discharge, detailed education for women will encourage preventative health care, prompt recognition, and treatment.

Our results indicate that episiotomy infections requiring medical attention are common and that most infections occur after hospital discharge, so that use of routine inpatient

Table III. Antibiotic susceptibility of gram-positive bacteria

Antibiotic	*S. aureus* (n = 122)		*S.epidermidis* (n = 82)		*Streptococcus spp.* (n = 261)		*E. faecalis* (n = 188)	
	S	R	S	R	S	R	S	R
Benzylpenicillin	28.3	71.7	30.7	69.3	35.2	64.8	72.9	27.1
Ampicillin	81.7	18.3	89.2	10.8	48.3	51.7	88.1	11.9
Oxacillin	82.7	17.3	79.6	20.4	NT	NT	NT	NT
Cefuroxime	88.9	17.1	78.6	21.4	94.1	5.9	38.8	61.2
Cefotaxime	82.5	17.5	89.8	10.2	85.2	14.8	NT	NT
Ceftriaxone	68.8	31.2	81.5	18.5	86.2	13.8	NT	NT
Imipenem	NT	NT	NT	NT	NT	NT	100.0	0
Gentamycin	87.4	12.6	91.5	8.5	91.2	8.8	81.1	18.8
Tobramycin	92.4	7.6	100.0	0	95.9	4.1	76.8	23.2
Ciprofloxacin	78.3	21.7	NT	NT	NT	NT	91.1	8.9
Levofloxacin	83.7	16.3	74.2	25.8	87.2	12.8	92.8	7.2
Erythromycin	34.1	65.9	28.4	71.6	31.2	68.8	15.1	84.9
Clindamycin	83.5	16.5	78.8	21.2	89.8	16.2	11.9	88.1
Linezolid	100.0	0	100.0	0	99.8	0.2	100.0	0
Vancomycin	100.0	0	100.0	0	NT	NT	93.2	6.8
Tigecycline	100.0	0	94.1	5.9	69.4	30.6	100.0	0
Fusidic acid	100.0	0	58.6	41.4	NT	NT	NT	NT

R, resistant isolates (%); S, susceptible isolates (%); NT, no tested;

Table IV. Antibiotic susceptibility of gram- negative bacteria

Antibiotic	*E. coli* (n=1423)		*Enterobacter spp.* (n=322)		*Klebsiella spp.* (n=255)		*Proteus spp.* (n=83)		*P. aeruginosa* (n=136)	
	S	R	S	R	S	R	S	R	S	R
Amoxicillin	65.2	34.8	NT	NT	NT	NT	70.4	29.6	NT	NT
AMC	78.1	21.9	39.8	60.2	85.2	14.8	84.3	15.7	NT	NT
Ticarcillin	69.9	30.1	92.7	7.3	NT	NT	86.5	13.5	81.9	18.1
TZP	96.3	3.7	96.5	3.5	100.0	0	100	0	77.2	22.8
Cefuroxime	63.8	36.2	77.4	22.6	87.6	12.4	NT	NT	NT	NT
Cefotaxime	87.1	12.9	96.1	3.9	88.3	11.7	98.8	1.2	NT	NT
Ceftriaxone	72.2	27.8	65.9	34.1	73.9	26.1	NT	NT	NT	NT
Ceftazidime	91.4	8.6	96.2	3.8	92.1	7.9	94.5	5.5	87.8	12.2
Cefepime	93.3	6.7	100.0	0	77.6	22.4	96.7	3.3	51.2	48.8
Imipenem	87.1	12.9	100.0	0	91.3	8.7	98.3	1.7	84.6	15.4
Meropenem	NT	NT	NT	NT	NT	NT	NT	NT	91.3	8.7
Ertapenem	100.0	0	100.0	0	100	0	100	0	100.0	0
Gentamycin	94.5	5.5	91,2	8.8	91.2	8.8	98.8	1.2	63.8	36.2
Amikacin	89.4	10.6	92.7	7.3	82.6	17.4	100.0	0	84.7	15.3
Ciprofloxacin	87.2	12.8	98.6	1.4	95.1	4.9	75.1	24.9	81.2	18.8
Levofloxacin	67.3	32.7	78.7	21.3	92.7	7.3	NT	NT	NT	NT
Cefoperazone	NT	NT	NT	NT	NT	NT	NT	NT	66.2	33.8

R, resistant isolates (%); S, susceptible isolates (%); NT, no tested; AMC, amoxicillin/clavulanic acid; TZP, piperacillin/tazobactam.

surveillance methods alone will lead to underestimation of episiotomy infections rates. Use of information collected from hospital and ambulatory records allows efficient identification of women who are very likely to have episiotomy infections.

Information resulting from more complete surveillance could be used to identify settings with unusually high or low infection rates to identify practices associated with lower infection rates. This information could then be used to focus, motivate, and assess the effectiveness of practice changes aimed at improving infection rates in all settings. Additional research is needed to evaluate the generalizability of this surveillance methodology, and to assess resource utilization associated with these infections. Strategic planning and implementation of postpartum infections surveillance is required.

CONCLUSIONS

Episiotomy infections in the puerperium are common in Ukraine and most of these infections caused by antibiotic-resistant bacteria. Postpartum episiotomy infection often begins and is diagnosed after discharge. Detailed education for women is needed, which can preventative health care, prompt recognition, and treatment. Antibiotics for treatment in episiotomy infection following vaginal delivery should be used in light of the local antimicrobial resistance data. Optimizing the management and empirical antimicrobial therapy may reduce the burden of episiotomy infections, but prevention is the key element. Knowledge about local data of resistance may contribute to limiting resistance and may have a significant role in designing effective antimicrobial stewardship policies.

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Conflict of interest:
The Authors declare no conflict of interest.

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