

## Evaluation of risk factors and the epidemiological pattern of nosocomial infection after gynaecological surgery in Ahvaz Imam Khomeini Hospital during the period 2011–2016

### *Ocena czynników ryzyka i schemat epidemiologiczny zakażeń szpitalnych po operacjach ginekologicznych w Szpitalu im. Imama Chomejniego w Ahwazie w latach 2011–2016*

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**Key words:** nosocomial infection, gynaecological surgery, postoperative infections, Ahvaz, Iran.

**Słowa kluczowe:** zakażenie szpitalne, chirurgia ginekologiczna, zakażenia pooperacyjne, Ahvaz, Iran.

#### Abstract

**Introduction:** Postoperative infections are among the most common complications after many surgical procedures, especially after gynaecological surgeries.

**Aim of the research:** The evaluation of risk factors and the epidemiological pattern of nosocomial infection after gynaecological surgery.

**Material and methods:** In a descriptive epidemiological hospital-based study, all patients who had reported at Imam Khomeini Hospital Infection Control Unit after Gynaecological Surgery from the beginning of April 2011 to the end of March 2016 were included in the study. Then, the demographic information and details about infections were extracted from the patient's records and recorded in the pre-determined checklists and analysed by SPSS version 22 software.

**Results and conclusions:** The average age of the patients was 30.59 ±9.52 years, and 11.6% of patients had diabetes, 7.1% had hypertension, and 81.3% had no underlying disease. The type of surgery performed in 78.8% of patients was caesarean section, 11.1% hysterectomy, 2% laparotomy, 4% episiotomy, and 4% other surgical procedures. 22.2% of the patients underwent the surgery in the elective state and 77.8% in the emergency condition, and *Escherichia coli* were more frequent than other microorganisms. Patients within the age range 25 to 35 years undergoing caesarean section in the emergency situation in winter and having diabetes were more susceptible to postoperative infections than others, and *Escherichia coli* was the most common microorganism in these patients.

#### Streszczenie

**Wprowadzenie:** Zakażenia pooperacyjne należą do najczęstszych powikłań towarzyszących zabiegom chirurgicznym, zwłaszcza operacjom ginekologicznym.

**Cel pracy:** Ocena czynników ryzyka i schemat epidemiologiczny zakażeń szpitalnych po operacjach ginekologicznych.

**Materiał i metody:** Do szpitalnego opisowego badania epidemiologicznego włączono wszystkie pacjentki, które zgłosiły się na oddział zakażeń Szpitala im. imama Chomejniego w Ahwazie po operacji ginekologicznej od początku kwietnia 2011 r. do końca marca 2016 r. Z dokumentacji medycznej pacjentek uzyskano dane demograficzne i szczegółowe informacje dotyczące zakażeń. Dane wprowadzono do wcześniej opracowanych list kontrolnych i poddano analizie przy wykorzystaniu oprogramowania SPSS (wersja 22).

**Wyniki i wnioski:** Średni wiek pacjentek wynosił 30,59 ±9,52 roku. Ogółem 11,6% pacjentek chorowało na cukrzycę, a 7,1% na nadciśnienie tętnicze. U 81,3% pacjentek nie występowała żadna choroba podstawowa. U analizowanych kobiet przeprowadzono następujące interwencje chirurgiczne: cięcie cesarskie – 78,8%, histerektomia – 11,1%, laparotomia – 2%, episiotomia – 4%, inne zabiegi chirurgiczne – 4% pacjentek. U 22,2% pacjentek operację wykonano w trybie planowym, a u 77,8% w trybie nagłym. Najczęściej izolowanym drobnoustrojem były bakterie *Escherichia coli*. Większą podatność na zakażenia pooperacyjne stwierdzono u pacjentek w przedziale wiekowym 25–35 lat po zabiegu metodą cięcia cesarskiego w trybie nagłym w okresie zimowym i u chorych na cukrzycę. Najczęściej izolowanym drobnoustrojem u tych pacjentek była pałeczka okrężnicy (*Escherichia coli*).

## Introduction

Nosocomial infection is not present at the beginning of a patient's hospitalisation or during hospitalisation or post-discharge [1]. Millions of dollars are used worldwide to diagnose, treat, and compensate for complications of nosocomial infection, which is one of the main causes of mortality in patients across the world [1–3]. The prevalence of nosocomial infections in the world is between 5% and 25% [2], i.e. this level cannot be expected to be zero even in the best equipped centres, so each centre should have the latest information in this regard and try to reduce it. In Iran, the Centre for Disease Management in the Ministry of Health and Medical Education has reported numbers in the same range for nosocomial infection in different centres [4, 5]. Healthcare-associated infections (HAI) are one of the most common and severe complications of hospitalisation and are a serious threat to the health of the hospitalised patients [6]. These conditions increase the risk of diseases and death, and increase hospital costs due to the increasing number of hospital days, long-term diagnostic and therapeutic care, and long-term absence from work and family [3]. Nosocomial infections may affect any part of the body, but the most common types of nosocomial infections are: urinary tract infection, respiratory infections, surgical site infections, septicæmia, and other types of infections (AIDS and hepatitis) [1–3]. Among the HAI cases, surgical site infection (SSI) occurs after surgery. A surgical site infection is defined as the occurrence of any infection in the opened tissue or organ and the manipulated cavity during surgery [7]. The term SSI replaced the term surgical wound infection in 1992 [8]. Postoperative infections are among the most common complications after many surgical procedures, sometimes even leading to the failure of surgical goals and causing irreparable injury to the patient [9, 10]. Surgical site infection occurs in 5–10% of the patients [1–5]. Common causes include Gram-positive cocci and Gram-negative bacilli [1–3]. The most common of the Gram-positive cocci is *Staphylococcus aureus*, which is found abundantly in the patient's skin and transferred to the patient, especially to the surgical site from the hands of the hospital staff. Gram-negative bacilli include *Escherichia coli*, *Klebsiella*, and *Pseudomonas*. Several factors make the wound susceptible to the next infection, which are classified into three categories: A) patient factors, including: old age, immune deficiency, obesity, diabetes mellitus, malnutrition, peripheral vascular disease, anaemia, and recent surgery; B) local factors, including: pre-surgery skin contamination, equipment contamination, inadequate pre-operative antibiotic prophylaxis, prolonged operation time, topical necrosis, hypoxia, and low body temperature (hypothermia); and C) microbial

agents, including long-term admission, toxin secretion, and antibiotic resistance [11]. Surgical wounds are divided into four categories: clean, contaminated clean, contaminated, and dirty. Several methods have been used to reduce the risk of post-operative infections, such as heat therapy, oxygen therapy, antibiotics, surgical site preparation, sterilization of surgical instruments, and, most importantly, preoperative skin preparation [11]. Considering the number of hospitalised patients in the Department of Obstetrics and Gynaecology, preventing the spread of hospital infection in these patients is of particular importance because, in addition to physical and psychological damage to the patient, surgical infection increases the cost of treatment, bed occupancy rate, duration of stay in the hospital, and the incidence of postoperative complications in women.

## Aim of the research

Because few studies have been conducted and implemented in this field in Khuzestan Province, this study was designed and conducted to investigate the predisposing factors and determine the epidemiological pattern of postoperative infection in patients admitted to the Department of Obstetrics and Gynaecology of Imam Khomeini Hospital in Ahvaz.

## Material and methods

After obtaining permission from the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran, the records of all patients who had reported to Imam Khomeini Hospital Infection Control Unit from the beginning of April 2011 to the end of March 2016 were included in a descriptive study to evaluate the parameters affecting surgical sites in patients admitted to the Department of Obstetrics and Gynaecology of Imam Khomeini Hospital in Ahvaz, were reported as surgical infection sites of gynaecological surgery. According to the instructions for the control of nosocomial infections of the Ministry of Health and Medical Education Department, postoperative infection is defined as an infection that occurs within one month of surgery and has infectious secretions (colour, odour, and abnormal volume) as an infectious surgical wound, and the scar specimen is also positive. All cases were carefully reviewed. Individual information such as patient's age, history of specific diseases, history of surgery, etc. were extracted from the patient's records, and other information, such as the type of surgery, emergency or elective surgery, and any signs of infection including fever, secretions from the surgical site, the type of antibiotic received before surgery, and the type of microorganism grown from the wound secretions, were extracted from the patient's records and recorded in pre-determined checklists.

**Table 1.** Patient characterisation and frequency of variables in patients

Variables		Number	Percentage
Age	< 25	51	25.8
	25–35	99	50.0
	> 35	48	24.2
Basic diseases	Diabetes	23	11.6
	Hypertension	14	7.1
	Without basic diseases	161	81.3
Surgery type	Caesarean	156	78.8
	Hysterectomy	22	11.1
	Laparotomy	4	2.0
	Episiotomy	8	4.0
	Other	8	4.0
Surgery condition	Elective	44	22.2
	Emergency	154	77.8
Microorganisms	CoNS and <i>E. coli</i> *	4	2.0
	CoPS and <i>E. coli</i> *	3	1.5
	<i>E. coli</i> and other*	7	3.5
	<i>E. coli</i> *	57	28.8
	CoPS*	14	7.1
	CoNS and other*	6	3.0
	CoNS*	40	20.2
	<i>Acinetobacter</i>	19	9.6
	<i>Klebsiella</i>	10	5.1
	<i>Pseudomonas aeruginosa</i>	8	4.0
	<i>Staphylococcus aureus</i>	15	7.6
	<i>Enterobacter</i>	8	4.0
	<i>Streptococcus</i>	7	3.5
Season of surgery	Spring	34	17.2
	Summer	46	23.2
	Autumn	54	27.3
	Winter	64	32.3
Invasive intervention (catheter)	Intravenous	192	97.0
	Intravenous and urinary	6	3.0

CoNS – coagulase-negative staphylococci, CoPS – coagulase-positive staphylococci, *E. coli* – *Escherichia coli*.

## Statistical analysis

The mean and standard deviation were used on quantitative variables, and frequency and percentage were used in qualitative variables to describe the data. All analyses were performed using SPSS version 22.

## Results

The average age of the patients was 30.59 ±9.52 years, range: 15–82 years. Of these, 25.8% of patients were within the age range of less than 25 years old, 50% in the age range of 25–35 years, and 24.2% were more than 35 years old. Most of the patients were between the ages of 25 and 35 years. In addition, 11.6% of patients had diabetes, 7.1% had hypertension, and 81.3% had no underlying disease. The prevalence of diabetes in patients was higher than elevated blood pressure. The type of surgery performed in 78.8% of patients was caesarean section, 11.1% hysterectomy, 2% laparotomy, 4% episiotomy, and 4% other surgical procedures. The most common operation was caesarean section. Moreover, 22.2% of the patients underwent the surgery in the elective state and 77.8% in the emergency condition. Therefore, the majority of patients underwent surgery in the emergency condition. The type of microorganism cultured in 2% of the patients were *Staphylococcus* coagulase negative + *Escherichia coli*, 1.5% *Staphylococcus* coagulase positive + *Escherichia coli*, 3.5% *Escherichia coli* + other microorganisms, 28.8% *Escherichia coli*, 7.1% *Staphylococcus* coagulase positive, 3% *Staphylococcus* coagulase negative + other microorganisms, 20.2% *Staphylococcus* coagulase negative, 9.6% *Acinetobacter*, 5.1% *Klebsiella*, 4% *Pseudomonas aeruginosa*, 7.6% *Staphylococcus aureus*, 4% *Enterobacter*, and 3.5% *Streptococcus*. Therefore, this study showed that *Escherichia coli* was the most frequently cultivated microorganism (Table 1).

The surgery was performed in 17.2% of patients in spring, 23.2% in summer, 27.3% in fall, and 32.3% in winter. Most patients had surgery in the winter. Invasive intervention for patients also showed that venous catheter was used for 97% of patients, intravenous catheter with urinary catheter was used for 3% of patients, and only intravenous catheter was used for the majority of patients. Regarding the importance of the type of microorganisms in nosocomial infections, this chapter examines the frequency of microorganisms in humans based on the study variables. It should be noted that the age range of the three categories of below 25 years old, 25 to 35 years old, and over 30 years old, diabetes and hypertension for type of disease, caesarean section and hysterectomy surgery for type of surgery, emergency and elective conditions for surgical condition, and finally the seasons of spring, summer, autumn, and winter during which the surgery took place were evaluated as variables in this chapter. *Escherichia coli* was more frequent than

other microorganisms in all cases except in the case of hysterectomy and in autumn, for which positive staphylococcus coagulase was more frequent.

## Discussion and conclusions

As mentioned in the results chapter, patients within the age range 25 to 35 years, those undergoing caesarean section, in winter, and having diabetes were more susceptible to postoperative infections than others, which should be considered by medical and nursing teams, medical science researchers, and health managers. Studies by other researchers were reviewed in order to compare the results of this study with other research done in this field. In the study by Yazdani *et al.* the use of immunosuppressive drugs (OR = 2.28), emergency operations (OR = 4.52), and diabetes mellitus (OR = 3.72) were identified as risk factors for nosocomial infection within 10 days of surgery [12]. The causes of diabetes and the emergency operation in their study were similar to the high prevalence of diabetes and emergency procedures in this study. Of course, in their study, the initial research population included all patients undergoing surgery, and the infection was studied. However, in the present study, the research population included patients who had a history of postoperative infections. However, this research population provided a better base for conducting more surgical operations with more variables that were not studied by Yazdani *et al.* In the study of Krieger *et al.* caesarean section followed by obesity (2OR), previous caesarean section (1.8OR), hypertension disorder (1.4OR), early rupture of membranes (1.3OR), pregnancy diabetes (1.2OR), and repetitive abortions (1.2OR) were the independent risk factors in patients who had undergone surgical site infection [13]. As in the present study, in the study by Krieger *et al.* diabetes and hypertension were among the variables associated with infection. The present study also looked at other surgical procedures in women, while Kriger *et al.* studied only caesarean section. Another study was conducted by Tuomi *et al.*, which looked at women with hysterectomy for endometrial carcinoma. It was reported that a body mass index (BMI) greater than 30 kg/m<sup>2</sup>, diabetes, and prolonged operation time with high risk of infection at the site of surgical incision, smoking, and lymphadenectomy are related to higher risk of infection in the organ [14]. The focus of their study was more on the location of the infection, but the common point in both studies was the high prevalence of diabetes. In addition, only hysterectomy patients were included in their study, while in the present study, other surgical operations related to women are also reviewed. A study by Mahdi *et al.* stated that cutaneous infection in women undergoing laparotomy was 3.5 times higher than the less invasive surgery [15]. Although the focus of Mahdi *et al.* was on female malignancies alone, they reached a different conclu-

sion from the present study because caesarean section and hysterectomy were more common in the present study, while laparotomy was more commonly reported than any other infections in their study, which might be due to the difference in the study population, the different surgeons, and the difference in the time of surgery, which call for further studies. A population-based study by Schneid-Kofman *et al.* identified obesity (OR = 2.2), blood pressure (OR = 1.7), premature rupture of membranes (OR = 1.5), diabetes (OR = 1.4), emergency caesarean section (OR = 1.3), and giving birth to twins (OR = 1.6) as independent risk factors [16]. The present study mentioned diabetes, caesarean section, and emergency surgery among other variables as risk factors for infection. However, their study described these variables as predictors of postoperative infections. While in the present study, the frequencies of these variables are studied. In conclusion of both studies, caesarean section, diabetes, and emergency surgery were significantly associated with postoperative infections. Research results on the microorganisms derived from the cultivation of patients showed different results. Dhaliwal *et al.* reported that abdominal hysterectomy had a higher rate of infection compared to vaginal surgery, and the microorganisms most often responsible for infection were *Enterococcus*, *Staphylococcus*, and *Klebsiella* [17]. Unlike these results, caesarean section was more prevalent in the present study, and regarding the microorganisms cultured, it was found that *Escherichia coli* and the subsequent coagulase-negative Staphylococci were most prevalent, which could be due to differences in the research population and the different locations of studies. Chia *et al.* reported in their study that the highest rate of wound infection was related to hysterectomy and the lowest rate was related to laparoscopy, and most of the organisms were *Staphylococcus aureus*. Wound infection was higher in some crowded areas and among some surgeons [18]. Contrary to their study, *Staphylococcus aureus* alone was responsible for 7.6% of infections in the present study, while *Escherichia coli* was found in more than 28.8% of the cultures from patients. Unlike them, caesarean section was the most frequent in this study. Obviously, the studies reviewed in this section are just a few of the studies conducted on the predisposing factors of post-operative infections in women. Further studies and comparisons of findings with other studies further reinforce the findings of the present study. The results of this study and the review of other studies show that patients within the age range 25 to 35 years undergoing caesarean section in the emergency situation in winter and having diabetes are more susceptible to postoperative infections than others. Furthermore, *Escherichia coli* was the most common microorganism. In addition, what this study shared with other international studies was that diabetes and emergency surgery were more common



than other variables in patients with postoperative infections. These cases require more attention from medical and nursing groups and healthcare managers.

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### Conflict of interest

The authors declare no conflict of interest.

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