Research Article

Antibiotic Use in Cesarean Section among Obstetricians and Gynecologists in the Second Largest City in Indonesia

Penggunaan Antibiotik pada Operasi Sesar oleh Dokter Obstetri dan Ginekologi di Kota Terbesar Kedua di Indonesia

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Abstract

Objective: To evaluate the pattern of antibiotic use in cesarean section `by obstetricians in Surabaya, Indonesia.

Methods: This was a descriptive observational study with a cross-sectional method. Study data were obtained from online interviews using electronic forms. This study used a total sampling method taken from obstetricians and gynecologists in Surabaya, Indonesia. The primary outcome of this study was a pattern of antibiotic use, including prophylactic use, selection of antibiotics, the timing of administration, additional antibiotics during and after surgery, and consideration of choice.

Results: The majority of antibiotics used in CS are in line with the guidelines. The types of prophylactic antibiotics (iv) used are varied; the majority were cefazoline (74.5%), ceftriaxone (14.5%), and cefotaxime (11.6%). Most antibiotics were administered <30 minutes before surgery. 2.5% of obstetricians routinely added antibiotics during a cesarean, while 33% were based on a particular condition such as prolonged surgery, massive bleeding, or risk of infections. The selection of antibiotics by obstetricians was based on protocols followed in the hospital (44.5%).

Conclusion: This study demonstrates that most obstetricians utilized antibiotic prophylaxis appropriately and followed guidelines for Cesarean Section.

Keywords: antibiotic, cesarean section, maternal health, obstetricians.

Abstrak

Tujuan: *Untuk mengevaluasi pola penggunaan antibiotik pada seksio sesarea oleh dokter kandungan di Surabaya, Indonesia.*

Metode: *Ini merupakan studi deskriptif observasional dengan metode pengambilan data potong lintang. Data studi diperoleh dari wawancara online dengan menggunakan formulir elektronik. Studi ini menggunakan total sampling dari dokter obstetri dan ginekologi di Surabaya, Indonesia. Hasil utama dari penelitian ini adalah pola penggunaan antibiotik, termasuk penggunaan profilaksis, pemilihan antibiotik, waktu pemberian, antibiotik tambahan selama dan setelah operasi, dan pertimbangan pilihan antibiotik tersebut.*

Hasil: *Mayoritas antibiotik yang digunakan pada seksio sesarea sesuai dengan pedoman. Jenis antibiotik profilaksis (iv) yang digunakan bervariasi, mayoritas adalah cefazoline (74,5%), ceftriaxone (14,5%), dan cefotaxime (11,6%). Sebagian besar antibiotik diberikan <30 menit sebelum operasi. 2,5% dokter kandungan rutin menambahkan antibiotik saat operasi sesar, sedangkan 33% didasarkan pada kondisi tertentu seperti operasi yang berkepanjangan, perdarahan masif, atau risiko infeksi. Pemilihan antibiotik oleh dokter kandungan berdasarkan protokol yang diikuti di rumah sakit (44,5%).*

Kesimpulan: *Studi ini menunjukkan bahwa sebagian besar dokter kandungan menggunakan profilaksis antibiotik dengan tepat dan mengikuti pedoman untuk operasi seksio sesaria.*

Kata kunci: *antibiotik, dokter kandungan, kesehatan ibu, operasi sesar.*

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INTRODUCTION

Cesarean section (CS) is the most frequently performed surgery in obstetrics and gynecology, and the trend is increasing annually. The World Health Organization (WHO) has released that the number of caesarean sections performed worldwide has increased and now accounts for more than 1 in 5 (21%) deliveries. According to the study, this number is expected to rise over the next ten years, with nearly a third (29%) of all newborns projected to be delivered via cesarean section by 2030[1]. The incidence of SC is much higher in private hospitals than in public hospitals. In Indonesia, a demographic health study involving 56,462 pregnant women showed that the CS prevalence rate had increased rapidly from 4% in 1998 to 18.5% in 2017. These figures in urban areas (22.9%) were double those in rural areas (11.8%).[2]

Prophylactic antibiotics are highly recommended for CS.[3–6] Antibiotic prophylaxis has been shown to reduce maternal morbidity, healthcare costs, and antibiotic overuse.[7,8] Prophylactic antibiotics can also reduce the risk of postoperative and surgical wound infections.[5–7,9,10] According to the Scottish Intercollegiate Guidelines Network's guidelines on antibiotic prophylaxis in surgeries, surgical antibiotic prophylaxis must be used appropriately thus, they must be supported by evidence of their efficacy and the effect of these antibiotics on the patient's normal bacterial flora and the patient's immune system must be minimized.

The inappropriate use of antibiotics can cause severe health problems, including antibiotic resistance.[11–16] Bacteria, viruses, fungi, and parasites can develop immunity to antibiotics, reducing the effectiveness of antibiotics.[14,15,17] According to the Centers for Disease Control and Prevention, approximately 2.8 million people in the US exhibit antibiotic resistance, and more than 35,000 people die yearly[16]. Antibiotic resistance develops when bacteria and fungi develop the ability to resist medications initially intended to eradicate them. Due to the otherwise surviving and growing bacteria, physicians must be cautious about this phenomenon.[18] Inappropriate antibiotic use, in terms of drug selection and administration timing, dose, and duration, is a critical factor in the emergence of antibiotic resistance.

Although recommendations for the use of antibiotics have been advised, in practice, antibiotic use in CS varies according to the attending obstetricians' judgment. Apart from following the guidelines, personal experience influences how obstetricians provide antibiotics during cesarean section. The purpose of this study was to describe the pattern of antibiotics use by obstetricians in Surabaya, including prophylactic use, selection of antibiotics, the timing of administration, additional antibiotics during and after surgery, and consideration of choice.

METHODS

This descriptive study was conducted in Surabaya, Indonesia, from July to August 2021. The ethical clearance was approved by the Ethical Committee of Universitas Airlangga Hospital (No. 138/KEP/2021), Surabaya, Indonesia. The research sample comprised obstetricians working in all hospitals in Surabaya. All obstetricians in Surabaya were included in this study based on the inclusion and exclusion criteria (total sampling size). Obstetricians who are practicing and performing cesarean sections actively mostly meet the inclusion requirements. The exclusion criterion was a participant who did not fully complete the questionnaire.

The trial's primary outcome was the pattern of antibiotic use in CS in cases of infection and non-infectious. The definition of infection cases was any type of infection in the mother that occurred during childbirth, both systemic infections and those localized to the uterus (e.g., chorioamnionitis and endometritis). The primary outcome of this study was the pattern of antibiotic use, including prophylactic use of antibiotics, selection of prophylactic antibiotics, the timing of antibiotic administration, the addition of antibiotics during and after surgery, and consideration of antibiotics. The clinical characteristics of the respondents were assessed based on age, work experience, and workplace. The healthcare center is divided into primary, secondary, and tertiary hospitals and exceptional hospitals for mothers and children. The type of hospital is distinguished based on the completeness of the type of health services that can be provided and the number of beds and health personnel available.

The research data were obtained from online electronic forms (Google Forms) interviews. We provided a questionnaire of 27 questions related to general characteristics and the use of antibiotics

in cesarean section. The research team contacted prospective study participants, provided information regarding the study, and obtained informed consent from participants. The study participants then completed the questionnaire, and the researcher collected the data. The data were displayed as descriptive statistics as some participants were affected and percentages from total participants. The data collected from the questionnaire is then cleaned to separate biased data. For easier reading results, the data is visualized as a table containing the amount and percentage of each question variable. Then, the data were analyzed descriptively by interpreting the percentage of respondents' answers.

RESULTS

Two hundred obstetricians agreed to participate (50% response rate) in this study. The remaining obstetricians (211 people) did not respond due to the pandemic. Most participants (93.5%) were between the ages of 30 and 60 and had less than ten years of work experience (53.5%). Participants worked in various hospital settings, with the majority (39%) working in secondary and primary hospitals (33%). Classification "others" on hospital type refers to the obstetrician's practice outside the hospital, such as in the inpatient clinic (Table 1).

Table 1. Background Characteristics

Characteristics	N (%)
Ages (years old)	
30 – 39	67 (33.5)
40 – 49	65 (32.5)
50 – 59	55 (27.5)
60 – 69	11 (5.5)
70 - 79	2 (1)
Working Experience (years)	
>20	14 (7)
10 – 20	79 (39.5)
< 10	107 (53.5)
Hospital Type	
Tertiary care hospital	30 (15)
Secondary care hospital	78 (39)
Primary care hospital	66 (33)
Mother and Child hospital	4 (12)
Others	2 (1)

The pattern of antibiotics used in non-infected CS by an obstetrician is shown in Table 2. In non-infectious CS, all obstetricians used prophylactic antibiotics. The types of antibiotics (iv) varied; the majority were cefazoline (74.5%), ceftriaxone (14.5%), and cefotaxime (11.6%). The doses of prophylactic (iv) antibiotics used varied from 500 to 3000 mg, and most were administered <30 min before the surgery (79.5%). Of the participants, 2.5% administered additional antibiotics routinely during surgery. The other 33% were administered additional antibiotics during surgery based on prolonged surgery, bleeding > 1.5 liters, and a risk of infection. Of the participants, 28.5% continued IV antibiotics after CS for 1 to 7 days, although there was no sign of infection. Some participants continued to give oral antibiotics after surgery (32.8%). The most common oral antibiotics administered postoperatively were cefadroxil and amoxicillin for 3–7 days (Table 2).

Table 2. Antibiotics Used in Cesarean Section

Antibiotics Used	N (%)
Cesarean Section on Non-infected Cases	
Antibiotics Prophylactic used	
Yes	200 (100)
No	0
Type of Prophylactic Antibiotics Used (iv)	
Cefazoline	149 (74.5)
Ceftriaxone	29 (14.5)
Cefotaxime	23 (11.6)
Cefoperazone	2 (1)
Amoxicillin Clavulanic Acid	2 (1)
Cefuroxime	5 (2.5)
Ampicillin Sulbactam	4 (2)
Gentamycin	1 (0.5)
Erythromycin	1 (0.5)
Phosphomycin	1 (0.5)
Timing of antibiotics administration	
>30 minutes before CS	35 (17.5)
<30 minutes before CS	159 (79.5)
After abdominal incision	5 (2.5)
After cord clamping	1 (0.5)
Addition of antibiotics during surgery	
Yes	5 (2.5)
No	129 (64.5)
If necessary, based on the clinical judgment during surgery	66 (33)
What condition necessitates the addition of antibiotics?	
Prolong surgery	52 (78.7)
Bleeding > 1.5 L	29 (43.9)
Infection risk	11 (16.6)
Others	15 (22.7)
Antibiotics (IV) continued after cesarean	
Yes	57 (28.5)
No	143 (71.5)
Duration of antibiotics (IV) continued after cesarean (days)	
1	29 (50.8)
2	8 (14.0)
3	14 (24.5)
5	5 (8.7)
7	1 (1.7)

Antibiotics oral continued after cesarean without infection risk or complications	
Yes	65 (32.8)
No	133 (67.17)
Type of oral antibiotics given after cesarean	
Cefadroxil	38 (58.4)
Amoxicillin	14 (21.5)
Ciprofloxacin	6 (9.2)
Amoxicillin Clavulanic Acid	1 (1.53)
Cefixime	4 (6.1)
Levofloxacin	1 (1.5)
Duration of oral antibiotics continued after cesarean (days)	
3	18 (27.6)
4	1 (1.5)
5	39 (60)
6	1 (1.5)
7	6 (9.2)

In cases of CS with infection, all participants were administered antibiotics during surgery. The most common types of antibiotics administered during cesarean delivery in cases of infection were ceftriaxone, metronidazole, cefazolin, and cefotaxime by an IV line. These antibiotics can be administered alone or in combination with several antibiotics. Postoperative oral antibiotics were continued in 96% of participants, the most common being ceftriaxone, metronidazole, cefotaxime, and amoxicillin-clavulanate for 1–7 days (Table 3).

Table 3. Antibiotics Use in Infected Cases Caesarean Section

Antibiotics Used	N (%)
Cesarean Section on Infected Cases	
Type of Antibiotics (iv) administrated	
Ceftriaxone	93 (46.5)
Cefotaxime	36 (18)
Cefazoline	43 (21.5)
Ampicillin Sulbactam	12 (6)
Amoxicillin Clavulanic Acid	7 (3.5)
Gentamicin	15 (7.5)
Metronidazole	51 (25.5)
Cefuroxime	2 (1)
Meropenem	1 (0.5)
Amikacin	2 (1)
Amoxicillin	1 (0.5)
Antibiotics continued after cesarean	
Yes	192 (96)
No	8 (4)
Type of Antibiotics administrated	
after cesarean	88 (45.8)
Ceftriaxone	33 (17.1)
Cefotaxime	7 (3.6)
Cefazoline	15 (7.8)
Ampicillin Sulbactam	25 (13.1)
Amoxicillin Clavulanic acid	17 (8.8)
Gentamycin	69 (35.9)
Metronidazole	1 (0.5)
Cefuroxime	1 (0.5)
Cefixime	3 (1.5)
Cefadroxil	2 (1.0)
Amikacin	
Duration of Antibiotics administrated after cesarean (days)	
1	1 (8.3)
2	19 (9.8)
3	91 (47.3)
4	1 (0.5)
5	57 (29)
7	8 (4.1)

The selection of antibiotics by obstetricians was based on protocols followed in the hospital (44.5%), the latest scientific evidence (20%), followed by specialist doctor education (16%), recently attended scientific seminars (10%), and other reasons (9.5%).

DISCUSSION

This study showed that all obstetricians administered prophylactic antibiotics before CS. Cochrane studies have shown that using prophylactic antibiotics in a CS can reduce superficial perineal wound infection, deep perineal wound infection, and probably wound breakdown.[19] However, the choice of prophylactic antibiotic administered is still highly varied. Most obstetricians used cefazoline (1st generation cephalosporin) as an intravenous prophylactic antibiotic at a dose of 2 g (93.2%); the remaining used 1–2 g. The rest use various antibiotics, including 2nd and 3rd generation cephalosporins. The pattern of prophylactic usage of broad-spectrum antibiotics is predominantly prevalent in Asian countries. Most obstetricians administered prophylactic antibiotics either less or more than 30 min before CS. Only five obstetricians gave antibiotics after the abdominal incision, and one received antibiotics after cord clamping. The WHO recommends administering prophylactic antibiotics for CS using a single dose of 1st generation cephalosporin between 30 and 60 minutes before surgery.[5] Using a single dose of CS prophylactic antibiotics can reduce costs, potential toxicity, and the risk of colonization by resistant microorganisms. The American College of Obstetricians and Gynecologists also recommends using a first-generation cephalosporin as the antibiotic of choice for SC prophylaxis.[4] The guidelines from the American Society of Health-System Pharmacists and the Society of Obstetricians and Gynecologists of

Canada also recommend using a single dose of a first-generation cephalosporin 15–60 minutes before incision.[20] A meta-analysis involving 16,328 pregnant women who underwent CS showed that cefazolin prophylaxis might reduce the risk of post-SC surgical site infection (SSI).[21] Two obstetricians still used amoxicillin-clavulanate as prophylactic antibiotics, contrary to the WHO recommendations, which prohibit amoxicillin-clavulanate as a prophylactic antibiotic because it increases the risk of necrotizing enterocolitis, particularly in preterm infants.[5] Most obstetricians used cefazolin as a prophylactic antibiotic at 2 g intravenously. The ACOG recommends determining the dose of prophylactic antibiotics based on maternal weight. Pregnant women with weights < 80 kg can be administered 1 g of cefazolin, while women with weights > 80 kg can be administered 2 g intravenously.[4] However, in Indonesia, The Indonesian Society of Obstetricians and Gynecologists (POGI) recommends the prophylactic use of cefazolin at a 2 g for all CS. The Indonesian Ministry of Health and the WHO's Indonesian wing have issued the latest guidelines on antimicrobial stewardship, aiming to regulate the use of antibiotics at the hospital.[22]

Regarding the timing of antibiotics, it was found that 3% of obstetricians administered antibiotics after abdominal incisions. The WHO recommends administering prophylactic antibiotics 30–60 minutes before surgery, while the ACOG recommends it within 60 minutes.[4,5] A systematic study showed that administering antibiotics within 60 minutes before an incision can reduce the risk of postpartum endometritis (43%), surgical wound infection (38%), and morbidity due to infection (28%) without interfering the neonatal outcomes, compared to mothers who were administered antibiotics after cord clamping.[23]

This study found that five obstetricians routinely administered additional antibiotics during CS. Meanwhile, 33% administered additional antibiotics only in special conditions (bleeding, prolonged surgery, or cases of high risk of infection), following the applicable recommendations. The WHO recommends special conditions that may increase the risk of postoperative infection (high body mass index (BMI)) prolonged labor, prolonged operative time, profuse bleeding, or extensive surgical manipulation). Antibiotics can be adjusted at higher or additional doses.[5] In one study, the administration of an additional antibiotic at the time of CS surgery (azithromycin 500 mg IV for 1 h) significantly reduced the risk of endometritis, surgical site infection, and other postoperative infections (relative risk (RR) 0.51, $p<0.001$).[24] However, this has not been officially recommended in international guidelines[3–5]

The present study found that some obstetricians continued routinely administering antibiotics after CS, either IV (28%) or orally (32.8%). The type of IV antibiotics used is the same as the prophylactic antibiotics; only the duration is extended postoperatively; the majority are between 1–3 days. Furthermore, some obstetricians and gynecologists also administer routine oral antibiotics post-SC, although there is no risk of infection. Cefadroxil and amoxicillin are the main types of oral antibiotics administered, lasting 3–5 days. To date, there is no substantial evidence supporting this routine protocol. A study involving 301 patients who underwent elective CS showed that prolonging IV antibiotics after CS for 72 h does not reduce the SSI risk.[25] The routine use of oral antibiotics after CS may not be appropriate because they are not prophylactic or therapeutic and are not based on the presence or absence of infection. Prolonging prophylactic antibiotic use can also trigger the emergence of antibiotic-resistant bacteria. The main rationale for antibiotic use is the shortest possible time to minimize side effects, develop bacterial resistance, and reduce hospital costs.[26] The use of antibiotics after CS may be considered under special conditions, such as obesity. This is supported by a randomized controlled trial involving 402 obese women who received additional antibiotics, metronidazole 500 mg and cephalexin 500 mg, for 48 h after CS. The intervention group had a lower risk of surgical wound infection than the control group (RR, 0.41; 95% CI: 0.22-0.77; $p=0.01$).[27]

We also evaluated the administration of antibiotics in CS surgery in cases of infection. All obstetricians provided therapeutic antibiotics during surgery with various choices, mainly by IV ceftriaxone, metronidazole, cefazoline, and cefotaxime. Similar oral antibiotics were administered postoperatively for 1–7 days. Antibiotics are only administered empirically before bacterial culture and antibiotic sensitivity tests are available. After surgery, generally, only the initially administered antibiotics are continued because the examination of bacterial cultures is complex in Indonesia. Not all health

facilities can perform bacterial cultures; some have to refer samples to a higher health center or external laboratory for cultures. Moreover, antibiotics were continued post-surgery based on the results of the germ culture.

This study shows that most antibiotic selections by obstetricians do not follow the hospital protocol (<50%). This may be attributed to the prevailing health system in Indonesia, where most obstetricians are not permanent employees of the hospital where they work; as a result, obstetricians' involvement and compliance with hospital service protocols are typically lower. In many countries, compliance with hospital protocols, specifically with the administration of antibiotics, remains a challenge.[26,28] In Indonesia, most obstetricians practice in more than one hospital (including private practice/clinic), lowering their adherence to the service protocol. This research reflects the mindset of obstetricians providing services at three hospitals.

Physician awareness and compliance with antibiotic use protocols in hospitals must be strengthened, as well as education, supervision, and hospital law enforcement. Additionally, professional organizations (POGI, IDI) should promptly develop standards for the use of antibiotics in obstetrics and gynecology; as a result, all obstetricians, regardless of the location, can practice uniformly.

One of the study's limitations was the study design. The data collection methods used were interviewing or conducting an online survey on daily practice, which are subjective and vulnerable to bias. Additionally, the details of cases were not analyzed, which may affect the antibiotics chosen by obstetricians. Additional trials using a prospective cohort design should be conducted to verify the findings of this preliminary study. This study also just included obstetricians in one big city in Indonesia.

CONCLUSIONS

This study showed that most obstetricians in Surabaya had used antibiotic prophylaxis for CS surgery appropriately and according to the guidelines. However, postoperative antibiotics should be corrected as it was not under the guidelines. Physician knowledge and compliance with antibiotic protocol in hospitals and professional organization (POGI, IDI) guidelines, education, supervision, and hospital law enforcement, must all be increased.

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