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Incidence of Surgical Site Infection following Caesarean Section and its Associated Risk Factors: Review of the Literature

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Abstract:
Caesarian section rate is increasing in both developed and developing countries. In Caesarian Section, surgical site infection is the most common postoperative complications with reported rates of 15%. Surgical site infection following Caesarian Section is a major cause of morbidity and mortality in women and it is increasing worldwide, in Saudi Arabia, 19.5% of the Surgical Site Infection is accounted to Caesarian Section. Many risk factors are associated with Surgical Site Infection following Caesarian Section such as type of Caesarian Section (elective or emergency), maternal age, gestational age, pregnancy complications and others. However, there is insufficient studies about the incidence of Surgical Site Infection following Caesarian Section and the associated risk factors in women who delivered by Caesarian Section. Therefore, the aim of literature review is reviewing the latest studies that investigate incidence of Surgical Site Infection following Caesarian Section and its related risk factors. Narrative review has been conducted using four search engines PubMed, CINAHL, EBSCO, and MEDLINE full text, English language from 2015 to 2020. 11 articles met the review criteria regarding the incidence of Surgical Site Infection and its associated risk factors representing 37,539 women from different countries developed and developing. This review of surgical site infections following cesarean section in different countries around the world found a surgical site–infection rate up to 38.4 % and majority of them associated to obesity, gestational age and undergoing emergency Caesarian Section.
Keywords: *cesarean section, elective cs, emergency cs, surgical site infection*

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I. Background

Globally 295 000 maternal death occurred in 2017 yielding an overall MMR of 211 death in 100 000 birth (WHO, 2017). Saving women life and minimizing the maternal mortality rate by 75% is the sustainable developmental goal #5 for 2030s. Infection is the third cause of maternal death based on the WHO report (2017). The Caesarian section rate is increasing in bothdeveloped and developing countries. In Saudi Arabia, the CS rate is exceeding the suggested optimal rate of CS by WHO (AlKadri et al., 2015).

The CS associated with severe complications such as infection or hemorrhage (Alfozan et al., 2019). Surgical site infection (SSI) following CS is a major cause of morbidity and mortality and it is increasing worldwide, in Saudi Arabia, 19.5% of the SSI accounted to CS (Alrowally et al., 2014). Surgical Site Infection is a well-known postoperative complication, with reported rates of 3 to 15%. (Zuarez et al., 2017).

The causes of surgical site infections are a considerable morbidity as well as substantial load to the health system, given such high Cesarean Delivery rates. It also increases the length of hospitalization and costs of community care following the discharge. (Krieger et al., 2017). The associated risk factors of the SSI following CS are emergency Cesarean deliveries, prolonged rupture of membrane and use of staplers for skin closure. (Jaiswal et al., 2020). Emergency CS is one of the significant risk factors for developing SSI. In Bangladesh, a recent study concluded that, Surgical site infection is more frequent among emergency caesarean deliveries and women who were un-booked. (Akhtar et al., 2020).

A similar study done in Oman incidence of surgical site infections following caesarian section and the associated risk factors showed, A higher infection rate was seen in emergency (119, 1.50%) in comparison with elective (92, 1.16%) Cesarean delivery cases. (Dhar et al., 2014). Emergency CS deliveries and improper antibiotic prophylaxis are significant risk factors in the process of developing surgical site infection, as was conducted at Farwania Hospital in Kuwait. (Alfouzan et al., 2019).

Other risk factors play a significant role in developing SSI following CS. Recent studies revealed that maternal age, maternal obesity, previous CS, hypertensive disorders, diabetes, preterm labor, premature rupture of membrane, and general anesthesia increased the risk for SSI following CS (Krieger et all., 2017). Surgical site infection following CS continues to be a major cause of maternal infection in the hospital settings both in developed and developing countries. To the best of our knowledge, there is a limitation of recent evidence exist

regarding the magnitude of SSI following CS in Saudi Arabia. Therefore, the study aims to determine the incidence of SSI among patients undergoing CS and the associated risk factors.

II. Methods

We performed a review of studies on the incidence and risk factors of SSI following CS, searched through electronic data base of PubMed, Saudi digital library through EBSCO, including Academic Search Ultimate, CINAHL Plus MEDLINE, MEDLINE Complete with Full Text, English language since 2015 to 2020. Was conducted using the term "caesarean" instead of "cesarean". The following key words were used: Cesarean delivery, incidence, surgical site infection, SSI, risk factors, emergency CS, and elective CS. While considering the research questions, the researcher extracted information from the sources which supported the rationale of the study and those which helped to answer the main research question. Key data and information such as findings on the incidence using provided sample size was also extracted from the identified articles.

A total of 11 studies reporting surgical site–infection rates after CS were identified, representative of 29,729 women from countries all over the world, developed and developing countries. along with a review that describes the mechanism of SSI and it associated risk factors for its occurrence and provides recent important clinical trials investigating preoperative, intraoperative, and postoperative practices to reduce SSI incidence.

III. Results

The review of the literature foundabout 11 Studies that investigate the incidence of SSI following CS and its related risk factors in last 5 years. Lijaemiro et al., (2019) conducted as prospective cohort study including 166 women who had CS within 30 days. The study used descriptive statistics, followed by bivariate and multivariable logistic regression to determine the incidence of SSI following CS and its related risk factors. Regarding the risk factors, the results reveled that older women have 1.5 higher risk in developing SSI following CS (AOR 1.5, 95% CI (1.17-193) similarly the duration of the operation increase the risk by 1.1 times (AOR 1.03, 95% CI (1.17- 1.93), also gestational age of > 40 weeks increases the risk by 0.02 times comparing to the term delivery from 37-40 weeks (AOR 0.02, 95% CI: 9 0.001-0.29). (Lijaemiro et al., 2019).

In a similar setting in Ethiopia, a prospective cohort study was conducted between March 28, 2019 and August 31, 2019, among 520 women post CS aimed to approximate the incidence of surgical site infection following caesarean section, using descriptive analysis of categorical variables through frequency tables, and interquartile ranges and medians for continuous variables. Which resulted in an incidence of surgical site infection following CS 25.4% with an incidence of 11.7 (95% CI:9.8,13.9) per 1000 person/days among women who were unable to read and write (AHR = 1.30,95% CI:1.19,2.11), women who did not have antenatal care (AHR = 2.16, 95%CI:1.05,4.53), having a history of CS (AHR = 1.21, 95%

CI:1.11,2.31), being HIV positive (AHR = 1.39, 95% CI:1.21,2.57), women who had emergency CS (AHR = 1.13, 95% CI:1.11,2.43), having vertical incision (AHR = 2.60, 95% CI:1.05,6.44), rupture of membrane (AHR = 1.50, 95% CI:1.31,1.64), women examined per vagina multiple times (AHR = 1.88, 95% CI: 1.71, 3.20). (Ketema et al., 2020).

A retrospective cohort study conducted from January 1st ,2016- 31 December 2017 in Bahrain including 1501 women who had CS to determine the incidence of CS and complications of CS. The findings of the study revealed that CS rate was increasing from 48.5% in 2016 to 51.4% in 2017. The most common CS complications was SSI which affected 2.9% of the cases in 2016 and 1.5% of the cases in 2017 (Abdulfattah et al., 2019).

According to a retrospective cohort study done at Nova scotia, 2017 to determine the incidence of SSI and its risk factors, in which 25 123 women were included between January 1, 1997 and December 31, 2012 via hospital database. A Logistic regression with generalized estimating equations was used to determine the risk factors for SSI which revealed an incidence of surgical site infection 2.7% (95% CI: 2.54%–2.89%). Risk factors for the infection were found in 15 women who had more than 1 SSI during the study period. The incidence of infection was higher after women were discharged (1.6% [95% CI 1.45%– 1.72%]) than before their discharge (1.1% [95% CI 1.02%– 1.24%]) ($p < 0.001$). women weighing 87.0 kg or more before pregnancy (95% CI 1.86 (1.42–2.43), women who gain 30.0 kg or more during pregnancy (95% CI: 2.14 (1.49–3.06), chorioamnionitis (95% CI: 2.47 (1.67–3.63), women who had blood transfusion during surgery (95% CI: 2.66 (1.53–4.62), having anticoagulation treatment (95% CI: 1.93 (1.03–3.63) , alcohol or drug abuse (95% CI: 1.71 (1.12–2.61) second stage of childbirth before surgery (95% CI:1.54 (1.27–1.88) all deliveries in 1997– 2000 and delivery in a hospital having 130–1249 CS annually (95% CI: 2.31 (1.88–2.84). Women who gave birth earlier in the study period, those who gave birth in a hospital with 130–949 CS per year (95% CI: 1.76 (1.34–2.30) and women who had twin pregnancy or more (95% CI: 1.78 (1.13–2.80) were at a significantly higher risk for SSI before discharge while women who smoked were at higher risk after the discharge (95% CI: 1.39 (1.13–1.70). (Ketcheson et al., 2017).

Alnajjar et al., 2020 aimed to look into the factors that may be associated to SSI following CS in AAH, Al Ain, UAE. A retrospective design was used to assess the risk factors for SSIs following CS among women at AAH who underwent the procedure from January 2016 and December 2017. women were followed up for 30 days post CS and women medical records were checked, and data were collected on potential risk factors using logistic regression and odd ratio. The study concluded an incidence of (1.4%) of SSI following CS and the main risk factor for developing surgical site infection was having a gestational age of more than 40 weeks (95% CI 4.35 0.013–1475.565) (Alnajjar et al., 2020).

According to a cross-sectional comparative study conducted at Hayatabad Medical Complex Peshawar from August 2014 to August 2015. Following 195 post-operative women who delivered by emergency and elective caesarean section. Those women were followed on the 3rd to 5th post-operative day and on 28th day thereafter. For quantitative variables such as mother's age and gestation Mean, and standard deviation was used. Frequency was used to calculate SSI. To compare SSI in emergency and elective LSCS Chi square test was applied. (SSI) was evaluated on 28th day in which Zahid et al discovered an incidence of wound infection of 38.4% post emergency CS while 15.3% post elective CS. The associated risk factors for SSI were having a BMI more than 35kg/m2, (10.3%) in elective CS and (23.1%) in emergency CS, having a gestational age more than 38 weeks was significantly high in emergency CS (41.5%) compared to elective CS (4%), women who were unable to read and write (23.1%) in emergency CS were affected while in elective CS they were (5.1%) and poor economic status was (41%) in emergency CS women while in elective CS it was (8.2%). (Kishwar et al., 2016).

In a similar study to compare the outcome in women who underwent emergency and elective CS. A prospective observational approach was conducted in Gynecology and Obstetrics department, Avicenna Medical College, Lahore over 6 months from July 2015 to December 2015. Seventy-eight women were included, women were divided in 2 groups. Group A (emergency CS), Group B (elective CS). Wound infection post CS was one of the most common and frequent complications specially among Group A where the incidence was 38.4% compared to a rate 15.3% for in group B. (Zahid et al., 2016).

In prospective study done in Jorden by Abdel Jalil et al., (2017) aiming to identify the factors related to the increased incidence of SSIs in which postoperative patients were followed up by phone calls and retrospectively by reviewing their wound culture results and clinical notes in the hospital. Risk factors for SSIs were identified via logistic regression. Which resulted in detecting a high incidence of SSI of (14.4%) post CS. BMI of ≥36 before conceiving (95% CI: 2.24 (1.3–3.92), lower weight-adjusted cefazolin dose (95% CI: 0.97 (0.94–0.99), gestational age of more than 40 weeks (95% CI: 2.24 (1.3–3.92), an increased hospital stay longer than 3.5 days(95% CI: 2.3 (1.41–3.63) are independent risk factors for the development of surgical site infection following CS. (Abdel Jalil et al., 2017).

While in another study done at a Tertiary hospital of North Delhi, 2018 aiming to evaluate several risk factors in women with (SSI) following CS and compare these risk factors in women who did not have SSI following CS. After following up 200 women postoperatively who underwent CS were followed up to 30 days. Women were SSI divided into 2 groups; Group A who developed SSI and the ones who did not have SSI were Group B. Continuous variables were presented as mean ±SD, frequencies and percentages were used for categorical variables Categorical data among the two groups were compared by using Chi-square test. Comparison of normally distributed continuous variables between the two groups was done by using Student t-test. Non-normal distribuend continuous variables comparison was done by MannWhitney U test. The SSI rate was 21.5%, associated to post-operative anemia with adjusted OR (95% CI: 2.40 (1.064-5.38). (Bhartiya et al., 2018).

Aiming to determine the incidence rate and risk factors associated with surgical site infections in women who underwent CS at the University Clinical Center of Kosovo (UCCK), in the Obstetrics and Gynecology Clinic. A prospective observational cohort study involving 325 women scheduled for CS from January 2018 to September, was conducted Each woman was followed for 30-postoperatively. Descriptive statistical, univariate, and multivariate logistic regression analysis was performed. The overall results showed an incidence of SSI rate of 9.85% and the median time to SSI was on the 7th day postoperatively. Similar to the other studies the findings confirmed that; increased maternal age more 35 years (95% CI: 2.26 (0.90-5.66) along with decreased host immunity and associated co-morbidities increases the women's risk for SSI (95% CI: 7.35 (2.76-19.59), women with a history of previous CS were 7.4 times more likely to develop SSI compared to those who did not have a history of CS (95% 3.65 (1.35-9.89).
(Zejnullahu, et al., 2019).

Delivering through caesarean section can bring forth complications such as wound infection, bacteremia, UTI and endometritis. Wound infection is more common and most troublesome as a surgical site infection. In the case of emergency CS, wound infections are more common in emergency CS than in the case of elective CS. This is because in elective CS, the surgeons are well prepared and have a better mapping for incision than in emergency CS. There are Host related risk factors where maternal age, obesity, residence, diabetes previous CS and many others. And there are Pregnancy-related factors: hypertension disorders,

gestational diabetes mellitus, twin pregnancy, PROM, increased number of vaginal examinations, prolonged trial of labor before procedure, spinal anesthesia, chorioamnionitis and others. And lastly there are Procedure related factors, SSI was more common among emergency CS lack of prophylactic antibiotics, need for blood transfusion during surgery and longer duration of surgery. (ZuarezEaston, et al., 2017).

Limitation of the study:

This study concluded on the findings of other studies and given that only a limited number of studies was used, further research may be necessary so as to further explore more risk factors for SSI following CS as well as the incidence of SSI specially in Saudi Arabia. Given that SSI is affected by the quality of care provided to women which varies globally, it may be difficult to develop a specific incidence rate (Shree, et al., 2016). As such the study is limited to providing an approximation of the same.

IV. Discussion:

The cesarean deliveries rate is increasing globally, which does not have no benefits to our community and future generation and also causes a burden on the health care services. There is no explanation for the increasing cesarean delivery, but it is especially important to consider the maternal and fetal morbidity and mortality. Different regions vary in incidence of SSI and what might be associated with it and further research is suggested to this uncertain medical and practical differences. The recommended WHO rate for CS is 10- 15% annually.

The purpose of this review was to provide information on the incidence of surgical site infection following CS and what might be associated with it, in different countries around the world. We found infection rates ranging from 1.4 % to 38.4% observed more in underdeveloped and developing countries. This review also reinforced the notion that the SSI is more common in emergency CS procedures.

Our review also found CS rates of 17% to 51.4%, exceeding the recommended rate of WHO for the optimal rate of Caesarean deliveries, which ranges from 10% to 15% annually. Which puts women health's at higher risk for developing SSI and majority of them, seen in 5 studies out of the 11 are related to undergoing emergency CS. Furthermore, Emergency CS is one of the independent risk factors for SSI development, other risk factors such as maternal age, gestational age and obesity are the common risk factors for the development of SSI following CS.

V. Conclusion:

Our review of the incidence of surgical site infections following cesarean section in different regions around the world found a surgical site–infection rate of 1.4% to 38.4% which suggest a major attention to this postoperative complication.

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