Asian Journal of Medicine and Health
3(4): 1-6, 2017; Article no.AJMAH.31284

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Aerobic Bacteria from Surgical Wound Infections in Obstetrics and Gynecology Ward in Specialist Hospital Sokoto – North West Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Authors ASS, YKEI and BOO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author RFA managed the analyses of the study. Author ASS managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJMAH/2017/31284
Editor(s):
(1) Triveni Krishnan, Division of Virology, National Institute of Cholera and Enteric Diseases, Kolkata, India.
Reviewers:
(1) Patrick Akpaka, The University of the West Indies, St. Augustine, Trinidad & Toabgo.
(2) Masaaki Minami, Nagoya City University, Japan.
(3) Alain C. Juayang, Colegio San Augustin – Bacolod, Philippines.
(4) Shivani Satia, Lady Hardinge Medical College and Associated Hospitals, Delhi, India.
Complete Peer review History: http://www.sciencedomain.org/review-history/18450

Original Research Article

Received 29th December 2016
Accepted 22nd February 2017
Published 1st April 2017

ABSTRACT

Background: Surgical site infections (SSI) are the third most common hospital-acquired infections (HAI) and account for 14% to 16% of all such infections. About 8.9% of Cesarean deliveries results in surgical site infections. It is the most common abdominal surgery among women in developed and developing countries. Infections arising from caesarean section causes prolonged hospital stay and there is a widespread aversion to caesarean delivery in Sokoto State.
Aim: Our aim is to determine the occurrence of surgical site nosocomial infections in Obstetrics and Gynecology ward of specialist hospital Sokoto.
Methods: This was a prospective study of surgical patients admitted into the Obstetrics and Gynecology (O and G) ward for the period of January to July 2014. SSI was diagnosed and

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classified according to the CDC system of standardized surveillance criteria for defining surgical site infection. Wound swabs were collected and processed as per standard microbiology procedures; and susceptibility testing was carried out using a disc diffusion technique. Data was presented in tables and analyzed using Statistical Package for Social Sciences (SPSS) software (version 20.0).

Results: The overall incidence of SSI was 10.4%. Patients of age less than 20 years were not only the predominant patients who underwent surgical operations, but also had the highest frequency of infection rate (14.3%).Emergency cesarean section had a greater rate of infection (14.1%). *Staphylococcus* spp. was the most common aetiology.

Conclusions: Surgical Site Infection complicates surgeries in the Obstetrics and Gynaecology ward of Specialist hospital Sokoto and a system for surgical site infection surveillance with feedback of appropriate data to surgeons is highly recommended.

Keywords: Surgical wounds; nosocomial infections; surgical site infection; Sokoto State; Nigeria.

1. INTRODUCTION

Nosocomial infection is defined as a localized or systemic condition that results from adverse reaction to the presence of an infectious agent(s) or its toxin(s) that was not present or incubating at the time of admission to the hospital [1].

Surgical site infections (SSI) are the third most common hospital-acquired infections (HAI) and account for 14% to 16% of all such infections. It is an infection occurring within an operative area 30 days of a procedure [2].

These infections can be defined by their anatomic location into superficial infections (occurring in 47% of cases), deep infections (occurs about 23% of cases) and organ space infections (occurs in 30% of cases) [3]. It is the most surveyed and most frequent type of infection in low-and middle income countries with incidence rates ranging from 1.2 to 23.6 per 100 surgical procedures and a pooled incidence of 11.8%. By contrast, SSI rates vary between 1.2% and 5.2% in developed countries [4]. For example, almost half of studies focusing on specific types of infections were related to SSI probably because it can be identified more easily using clinical criteria.

Postoperative SSI remains a major source of illness and a less frequent cause of death in surgical patients, accounting for approximately a quarter of all nosocomial infections. The incidence of infection varies from surgeon to surgeon, from hospital to hospital, from one surgical procedure to another, and most importantly from one patient to another (infectious), from time to time. Thus, emerging and re-emerging, again and again [5]. It also varies from 0.5 to 15%, depending on the type of operation and underlying patient status [6].

Cesarean section (CS) is the most common abdominal surgery among women in developed and developing countries. The principal sources of morbidity after cesarean section in Nigeria are anemia and sepsis. A coalition of various risk criteria including - type of wound, surgical skill, maternal immunity, age, and weight, hypertensive disorders, virulence of microorganisms and premature rupture of membrane, are associated with surgical site infection following cesarean section [7].

Although there are various risk factors for surgical site infections, bacteria remains the major cause of the infection [8].

Our aim is to determine the occurrence of surgical site nosocomial infections in obstetrics and gynaecology (O&G) ward of specialist hospital Sokoto with a view of providing baseline information about the infection, minimizing their incidence and attendant health problems.

2. MATERIALS AND METHODS

This was a prospective study of surgical patients admitted into the O&G ward for the period of January to July 2014.

2.1 Ethical Consideration

Ethical clearance was obtained from the hospital management. Informed consent was obtained from all the patients recruited for the study before clinical samples were taken.

2.2 Inclusion and Exclusion Criteria

All patients of different ages who delivered by CS in the hospital and consented to the study were included in the study. Patients who were not willing to participate in the study and those who died during the procedure or immediately after CS were excluded from the study.

2.3 Patient Recruitments

The study patients were prospectively recruited consecutively from patients admitted for surgery. The patients were informed and their consent to participate in the study were obtained.

Recruited patients were observed and monitored for the development of surgical site infection right from the pre-operative stage through the postoperative period to the time of discharge from the hospital. Particular attention was paid to patients who developed postoperative SSI (septic wound) during the study period.

SSI was diagnosed and classified according to the CDC system of standardized surveillance criteria for defining surgical site infection. Patients were assessed for systemic (fever, chills) and local (pain, redness, warmth, swelling, purulent drainage) signs of infections and also if the sample obtained from the patients yielded a positive culture for nosocomial pathogens upon microbiological examinations.

2.4 Bacteriological Study of Surgical Sites

Immediately after the closure of the operated site, the wound site was swabbed using a sterile swab stick. The swab was then inoculated into 9ml sterile peptone water and transported to the microbiology laboratory. Each specimen was then inoculated on nutrient agar, blood agar and MacConkey agar. The plates were incubated aerobically at 37℃ for 24 hours. The colonies that developed after incubation were sub-cultured onto nutrient agar slant and stored in refrigerator for further characterization.

2.5 Detection of Surgical Site Infections (SSI)

The patients were examined regularly along with the medical team, the operation sites were inspected for signs of infection. Patient's files or folders were also checked regularly for information that might indicate signs of infection in the surgical sites.

An operation site is classified positive for SSI if

- There is a purulent discharge from the incision.
- An organism is isolated from the culture of fluid or tissue from the incision.
- At least one of the following is noticed: pain, tenderness, or heat.
- An infection that occurred within 30 days after operative procedures.

Instances where any of the above was noticed, the sites were swabbed using a sterile swab stick, inoculated in sterile peptone water broths, inoculated on nutrient agar and MacConkey and incubated at 37℃ for 24 to 48 hours.

2.6 Characterization of Bacteria Isolates

All specimens were processed in accordance with the standard microbiology procedures. Isolated bacteria from positive cultures were characterized based on their cultural, morphological and biochemical reactions following guidelines described in literature [9] and [10]. Biochemical tests that were performed on the isolates included:, catalase test citrate utilization, triple sugar iron test, coagulase test, indole test, methyl red and Voges-Proskauer Test, oxidase test and urease test [10].

2.7 Statistical Analysis

Analysis of data was done using Statistical Package for Social Sciences (SPSS) software (version 20.0, SPSS Inc, Chicago, IL). The percentages were used to calculate frequency rates. Chi-square test was used to compare the rates of infection with the months, the age of patients, and type of surgeries. P-value <0.05 was considered significant.

3. RESULTS

The results of the prospective studies of nosocomial infections in the O&G ward where surgical patients are admitted are presented in the following tables.

Table 1 shows the monthly distribution of SSI in O&G ward in the specialist hospital. The Table reveals that infection rate varied from month to month, from 4.7% in May, 2014 to 16.7% in

January, 2014. The Table also reveals an overall frequency rate of 10.4%.

Table 1. Monthly frequency of nosocomial surgical site infection in Obstetrics and Gynaecology ward of specialist hospital, Sokoto

Month	Total no. of patients	Total no. infected	Frequency rate%
January	18	3	16.7
February	27	4	14.8
March	11	1	9.1
April	11	1	9.1
May	21	1	4.7
June	13	1	7.6
July	4	0	0.0
Total	105	11	10.4

Table 2 shows the age distribution of patients with surgical site infection in the obstetrics and gynaecology wards from January to July, 2014. It reveals that patients of age less than 20 years were not only the predominant patients who underwent surgical operations, but also had the highest frequency of infection rate (14.3%).Patients over fifty years were few and had no infections at the surgical sites.

Table 2. Age distribution of patients with SSI in Obstetrics and Gynecology ward from January to July 2014

Age group	Total number of cases	No surgical SSI	Infection rate (%)
≤20	42	6	14.3
21-30	35	3	8.6
31-40	23	2	8.7
41-50	5	0	0.0
Total	105	11	10.4

Table 3, reveals that patients who underwent emergency Cesarean section had a greater rate of infection (14.1%) than elective Cesarean section (4.8%).

Table 3. Incidence of surgical site infection in Obstetrics and Gynaecology ward from January to July 2014

Type of surgery	Number of surgery	Number infected	Rate (%)
Emergency CS	64	9	14.1
Elective CS	41	2	4.8
	105	11	10.4

Table 4 shows bacterial isolates identified at the surgical site of patients admitted into the O & G wards of the hospital. *Staphylococcus* spp. (38.5%) constituted the majority among the isolates, though *Enterobacteriacea* organisms as a group accounted for almost half of the isolates.

Table 4. Distribution of pathogens at the surgical site from January to July, 2014

Isolated pathogen	Occurrence	% frequency
Staphylococcus spp. *	5	38.5
Enterobacter spp.	1	7.7
Escherichia coli	2	15.4
Klebsiella spp.	2	15.4
Pseudomonas spp. *	3	23.0
Total	13	100

*Key; * = Most virulent bacteria*

4. DISCUSSION

All over the world, nosocomial infection is reported as a foremost source of public health problem, because it continues to impede the successful management of infections in hospitals. World Health Organization [4] surveillance put the rate of infection at 5-10% of hospital admissions. The incidence of SSIs following Caesarean section obtained from this study is 10.4%, which falls within the average global CS infection rate of 15% [11]. This rate is, however, lower than what was reported in Tanzania which ranged from 21.4% to 31.8%. Data obtained from the prospective studies of the age distribution of SSI of patients in obstetrics and gynaecology ward revealed a higher rate of infection (14.3%) among patients of age 20 and below. There was no statistically significant relationship between the patient's age and the rate of infection ($P > 0.05$). This finding is similar to what was reported by Dalhatu et al*.* [12] about the same age group. The result is also similar to the report of Jido et al. [13]. This contradicts the finding of Kaye et al. [14] where an increase in age independently predicted an increase risk of SSI. Higher rates of infections due to increasing age are associated with greater likelihood of certain chronic conditions and decreased immunity with delayed healing, which is not the case in this study. The marital age of patients (≤ 20) in this region may have contributed to the high rate of infection among this age group. The highest rates of infection occurred with patients who underwent emergency Cesarean section (CS) with a rate of 14.1% compared to those who underwent elective CS with a rate of 4.8%. There was no statistically significant difference between the rate of SSI and the type of surgery ($P > 0.05$). This shows that emergency surgical interventions increased the rate of SSI. The

highest infection rate in emergency operation can be attributed to inadequate preoperative preparation and the severity of the underlying condition that necessitated emergency procedure. This agrees with the findings of Nwankwo et al. [15]. Preoperative antibiotic prophylaxis is an important preventive measure to reduce incidence of SSI. Early administration reduces the colonization pressure of microorganisms to a level that the patient's immune system will be able to overcome. Because emergency surgeries are carried out in a hurry, prophylaxis may not have been administered early enough to achieve the required serum and tissue concentrations. This may have led to the high rate of postoperative infection in emergency surgeries [16].

Another reason that has been advanced to explain high rates of infection in emergency surgeries is the development of subcutaneous wound hematomas (blood collection within tissues). Damage to smaller vessels that was not apparent during emergency surgeries is a major cause of the hematoma. This suggests lapses in complete haemostasis during the wound closure [17]. The blood collections in the wound may provide a medium for bacterial growth and as a result cause post operative surgical site infection [7].

The array of different surgical site infection pathogens obtained in this study could be associated with the fact that the microbial aetiology of post caesarean section SSI has been shown to be diverse, association with both vaginal microorganisms such as *E. coli, Enterococcus* spp., or with nasopharyngeal flora such as *Staphylococcus aureus, or* skin flora such as *Staphylococcus epidermidis*. *Staphylococcus aureus* has been found to be the most common cause of SSI post CS [18]. Other organisms such as *Escherichia coli, Klebsiella* spp., *Pseudomonas aeruginosa, Enterobacter* spp., *Enterococcus* spp., have all been implicated as surgical site pathogens in post CS cases [18].

Our study has a number of noteworthy limitations, the research only covered 6 months period and thus may not account for seasonal variation. Patients largely did not consent to participate in the study and thus were not included. Post discharge surveillance was not carried out in this study, this may have been useful to obtain more-accurate data. In general, given these constraints, our study is more likely to have underestimated the true frequency of infection.

5. CONCLUSION

Despite the antecedent limitations, this study still established that surgeries in the Obstetrics and Gynaecology ward of specialist hospital Sokoto are complicated by surgical site infection (10.4%). *Staphylococcal* spp and *Pseudomonas* spp were the most virulent pathogens recovered when compared to other organisms isolated in the study. The highest infection rates occurred in emergency surgical procedures and patients of age ≤ 20. Until such a time that optimal infection control measures and guidelines for post operative surgical site infection is feasible, a system for surgical site infection surveillance with feedback to surgeons is highly recommended.

ACKNOWLEDGEMENTS

We would like to thank the hospital management of specialist hospital Sokoto, Nigeria for their support to complete this study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/18450