



Prevalence and Microbial Etiology of Surgical Site Infections Following Major Abdominal Gynecologic Surgeries in a Tertiary Care Center

Authors

Dr Sujatha.T.L¹, Dr O.Sasikumari²

¹Additional Professor, Department of Obstetrics and Gynaecology, SATH, Thiruvananthapuram

²Assistant Professor, Department of Microbiology, Govt. Medical College, Thiruvananthapuram

ABSTRACT

Background and Objective- Surgical site infections (SSI) are one of the common healthcare associated infections and account for approximately a quarter of all nosocomial infections.. The risk factors and microbial etiology are different in various situations. Hence a study of the risk factors and microbial pattern associated with Surgical site infections will help to develop a treatment policy for the institution.

Materials and method- Data was collected during hospital stay and one month post operatively. Data was collected on important study variables including medical history and risk factors by the use of pretested interview schedule. Parameters like socioeconomic status was assessed by Kuppaswamy's socio economic status scale. Swabs taken from SSI were tested in the Department of Microbiology, Govt. Medical college, Thiruvananthapuram. for culture and sensitivity.

Results- A total of 1000 cases were studied during the study period and there were 138 cases (13.8%) of surgical site infection following major abdominal gynecologic surgeries. Of the total 138 cases of SSI micro organisms were isolated in 54 cases (31.8%). This included Klebsiella Species 23 cases (42.6%), Staphylococcus aureus 20 cases (37%), MRSA 9 cases (16.7%) and E coli. 2 cases(3.7%)

Low education status, low socio economic status, emergency nature of surgeries, diabetes, urinary tract infection and premature rupture of membranes for more than 12 hours were significant risk factors

Conclusion - Klebsiellaspp was the most common isolate obtained. Knowledge of microbial etiology and sensitivity pattern would be helpful regarding the use of prophylactic and therapeutic antibiotics.

Keywords- Abdominal surgery, surgical site infection, risk factors, LSCS.

INTRODUCTION

Surgical site infections are the most common healthcare associated infections and they account for approximately a quarter of all nosocomial infections. [1] They are responsible for increasing cost, morbidity and mortality related to surgical operations and continue to be a major problem even in hospitals with modern facilities, advances in infection control practices including improved

operation theatre, sterilization methods, surgical techniques and standard protocols of preoperative preparation and antibiotic prophylaxis.

Materials and method

A descriptive study was done in Sree Avittam Thirunal Hospital Thiruvananthapuram for a period of one year from January 2015 .The primary objective was to study the hospital incidence of Surgical Site Infections following

major gynecologic abdominal surgeries and to study the bacterial profile of such infections. The secondary objective was to find out the risk factors of Surgical Site Infections following major abdominal surgeries. A total of 1000 cases were studied during the study period

Inclusion Criteria- Patients who underwent emergency /elective major abdominal surgeries were taken for the study after taking consent. Major abdominal surgeries included Caesarean sections, laparotomies and abdominal hysterectomies.

Exclusion Criteria: Immuno compromised patients, Minilap, Vaginal surgery, Laparoscopic surgeries were excluded as the risk factors were not comparable.

Study Tools-

Interview Schedule –Socioeconomic status was assessed by Kuppuswamy's socio economic status scale. Medical history and assessment of risk factors were collected using pretested interview schedule.

Microbial Etiology: Swabs from Surgical site infections were sent for culture and sensitivity to the Department of Microbiology, Govt. Medical college, Thiruvananthapuram.

Study Variables

- Definition of Surgical site infection

Surgical site infection is defined as infection of the skin and subcutaneous tissues of the incision site, within 30 days of surgery. [2]

- Diagnosis of SSI was made if the patient had at least one of the following:
 - Localized swelling, redness or tenderness over the site.
 - Discharge from the incision site.
 - Organisms are isolated from the culture of the exudates from the incision site.

Data Collection

The patients who had undergone elective as well as emergency major abdominal surgeries were selected after taking informed consent. They were followed up post operatively till they got

discharged from the hospital and during the postoperative checkup after one month. If discharge from the wound was present it was sent for microbiological examination.

Data was also collected from every patient regarding the various risk factors and demographic factors, by means of a detailed interview schedule.

Statistical Analysis

Data was analysed in SPSS version 17.0 statistical software. Quantitative variables were assessed for approximate normal distribution and summarized as mean and standard deviation. Categorical variables summarized by frequency (percentage). For prevalence and Microbiological etiology, percentage distribution and 95% confidence limits were calculated.

To study the risk factors Odds Ratio and logistic regression was used. The association of each potential risk factor with SSI and bivariate significance, were assessed by chi-square test. Multivariate logistic regression with backward model selection criteria was carried out to find out the independent risk factors of surgical site infection. Relative risk with 95% confidence interval was assessed for each of the potential risk factor.

RESULTS

Table 1.Type of surgery

| Name of Surgery | Count | Percent |
|------------------|-------|---------|
| LSCS | 746 | 74.6 |
| TAH / Laparotomy | 254 | 25.4 |
| TOTAL | 1000 | 100% |

Table 2.Percentage distribution of the sample according to Surgical Site Infections

| Surgical Site Infections | Count | Percent |
|--------------------------|-------|---------|
| No | 862 | 86.2 |
| Yes | 138 | 13.8 |

Table 3. Distribution of surgical site infection based on type of surgery

| Name of Surgery | Count | Percent |
|-----------------|-------|---------|
| LSCS | 125 | 90.6% |
| Laparotomy | 13 | 9.4% |
| TOTAL | 138 | 100% |

Table 4. Nature of Caesarean surgery-

| Nature of Surgery | Count | Percent |
|-------------------|-------|---------|
| Elective CS | 182 | 24.4 |
| Emergency LSCS | 564 | 75.6 |
| Total | 746 | 100.0 |

Table 5. Percentage distribution of the sample according to socio economic status

| Socio economic status | Count | Percent |
|-----------------------|-------|---------|
| Lower | 628 | 62.8 |
| Upper lower | 345 | 34.5 |
| Lower middle | 27 | 2.7 |

Table 6. Percentage distribution of the sample according to presence of Diabetes

| Diabetes | Count | Percent |
|----------|-------|---------|
| Yes | 290 | 29.0 |
| No | 710 | 71.0 |

Table 7. Percentage distribution of the sample according to presence of hypertension

| Hypertension | Count | Percent |
|--------------|-------|---------|
| Yes | 362 | 36.2 |
| No | 638 | 63.8 |

Table 8. Percentage distribution of the sample according to hypothyroidism

| Hypothyroidism | Count | Percent |
|----------------|-------|---------|
| Yes | 178 | 17.8 |
| No | 822 | 82.2 |

Table 9. Percentage distribution of the sample according to UTI

| UTI | Count | Percent |
|-----|-------|---------|
| Yes | 199 | 19.9 |
| No | 801 | 80.1 |

Table 10. Percentage distribution of the sample according to Respiratory Tract Infections

| RTI | Count | Percent |
|-----|-------|---------|
| Yes | 131 | 13.1 |
| No | 869 | 86.9 |

Table 11. Percentage distribution of the sample according to PROM >12Hrs

| PROM>12Hrs | Count | Percent |
|------------|-------|---------|
| Yes | 150 | 20.1 |
| No | 596 | 79.9 |

Table 12. Percentage distribution of the sample according to selected variables

| Variable factors | Count | Percent |
|-------------------------|-------|---------|
| Post operative edema | 32 | 23.2 |
| Redness | 79 | 57.2 |
| Discharge | 103 | 74.6 |
| Positive culture report | 56 | 40.6 |

Table 13. Culture positivity in SSI

| Culture report | Count | Percent |
|----------------|-------|---------|
| Positive | 54 | 52.4 |
| Sterile | 49 | 47.6 |
| Total | 103 | 100 |

Table 14.Bacterial profile of SSI

| Organism | Count | Percent |
|------------------------------|-------|---------|
| <i>Klebsiella Species</i> | 23 | 42.6 |
| <i>MRSA</i> | 9 | 16.7 |
| <i>Staphylococcus aureus</i> | 20 | 37.0 |
| <i>E .coli</i> | 2 | 3.7 |
| TOTAL | 54 | |

Table 15. Antibiotic sensitivity pattern of Gram negative bacteria

| Antibiotics | <i>Klebsiellaspp</i> (23) | <i>E.coli</i> (2) |
|---|---------------------------|-------------------|
| Ampicillin | 0 (0 %) | 0 (0%) |
| Gentamicin | 3 (13%) | 2 (100%) |
| 1 st Generation Cephalosporins | 3 (13%) | 2 (100%) |
| Amikacin | 23 (100%) | 2 (100%) |
| 3 rd Generation Cephalosporins | 18 (78%) | 2 (100%) |
| Ciprofloxacin | 10 (43.5%) | 2 (100%) |
| Cefoperazone + sulbactam | 23 (100%) | 2 (100%) |
| Piperacillin+ Tazobactam | 23 (100%) | 2 (100%) |

Table 16.Antibiotic sensitivity pattern of *Staphylococcus aureus*

| Antibiotics | MSSA (20) | MRSA (9) |
|---|-----------|----------|
| Penicillin | 0 | 0 |
| Gentamicin | 10 | 0 |
| Erythromycin | 4 | 0 |
| 1 st Generation cephalosporins | 20 | 0 |
| Cefoxitin | 20 | 0 |
| Amikacin | 20 | 7 |
| Vancomycin | 20 | 9 |

Table 17. Comparison of surgical site infections based on selected variables

| | | Surgical Site Infections | | χ^2 | p | RR (95% CI) |
|-----------------------|-----------------------|--------------------------|------------|----------|-------|--------------------|
| | | No | Yes | | | |
| Age | <30 | 516 (83.8) | 100 (16.2) | 7.99** | 0.005 | 1 |
| | >30 | 346 (90.1) | 38 (9.9) | | | 1.46 (1.1 - 1.93) |
| Education | Upto Middle school | 560 (83.5) | 111 (16.5) | 12.9** | 0.000 | 1 |
| | High school and above | 302 (91.8) | 27 (8.2) | | | 1.79 (1.26 - 2.54) |
| Socio economic status | Lower | 519 (82.6) | 109 (17.4) | 17.95** | 0.000 | 1 |
| | Middle | 343 (92.2) | 29 (7.8) | | | 1.89 (1.36 - 2.64) |
| Name of Surgery | LSCS | 621 (83.2) | 125 (16.8) | 21.57** | 0.000 | 1 |
| | Laparotomy | 241 (94.9) | 13 (5.1) | | | 2.97 (1.75 - 5.03) |
| Name of Surgery | Elective CS | 161 (88.5) | 21 (11.5) | 4.7* | 0.030 | 1.08 (1.02 - 1.16) |
| | Emergency LSCS | 460 (81.6) | 104 (18.4) | | | 1 |
| Diabetes | Yes | 225 (77.6) | 65 (22.4) | 25.48** | 0.000 | 1 |
| | No | 637 (89.7) | 73 (10.3) | | | 1.4 (1.19 - 1.64) |
| Hypertension | Yes | 306 (84.5) | 56 (15.5) | 1.33 | 0.249 | 1 |
| | No | 556 (87.1) | 82 (12.9) | | | 1.09 (0.94 - 1.26) |
| UTI | Yes | 158 (79.4) | 41 (20.6) | 9.67** | 0.002 | 1 |
| | No | 704 (87.9) | 97 (12.1) | | | 1.16 (1.04 - 1.3) |
| RTI | Yes | 113 (86.3) | 18 (13.7) | 0 | 0.983 | 1.01 (0.63 - 1.6) |
| | No | 749 (86.2) | 120 (13.8) | | | 1 |
| | No | 505 (82) | 111 (18) | | | 1 |

** - Significant at 0.01 level, * - Significant at 0.05 level

Table 18. Comparison of duration and surgical site infections

| | | Surgical Site Infections | | χ^2 | p | Odds (95% CI) |
|------------|----------|--------------------------|-----------|----------|-------|--------------------|
| | | No | Yes | | | |
| LSCS | <0.75 hr | 316 (89.3) | 38 (10.7) | 4.15* | 0.042 | 1 |
| | >0.75 hr | 353 (84.2) | 66 (15.8) | | | 1.56 (1.01 - 2.38) |
| Laparotomy | <1.5 | 592 (86.2) | 95 (13.8) | 0.74 | 0.389 | 1.37 (0.67 - 2.83) |
| | >1.5 | 77 (89.5) | 9 (10.5) | | | 1 |

Table 19.Independent predictors of surgical site infection based on selected variables (Multiple logistic regression) for SSI following major abdominal surgeries

| | | B | SE | p | Odds (95% CI) |
|-------------------------------------|--------------------|------|------|-------|--------------------|
| Education (High school and above ®) | Upto Middle school | 0.73 | 0.26 | 0.005 | 2.08 (1.25 - 3.48) |
| Socio economic status (Middle ®) | Lower | 1.13 | 0.26 | 0.000 | 3.1 (1.86 - 5.16) |
| Diabetes (No ®) | Yes | 1.15 | 0.21 | 0.000 | 3.15 (2.08 - 4.75) |

Table 20. Comparison of surgical site infections based on selected variables for Laparotomy

| | | Surgical Infections | | Site | P | RR (95% CI) |
|-----------------------|-----------------------|---------------------|----------|------|-------|--------------------|
| | | No | Yes | | | |
| Age | <30 | 28 (93.3) | 2 (6.7) | 0.17 | 0.682 | 1 |
| | >30 | 213 (95.1) | 11 (4.9) | | | 1.04 (0.82 - 1.32) |
| Education | UptoMiddleschool | 176 (95.1) | 9 (4.9) | 0.09 | 0.764 | 1.05 (0.73 - 1.53) |
| | High school and above | 65 (94.2) | 4 (5.8) | | | 1 |
| Socio economic status | Lower | 175 (96.2) | 7 (3.8) | 2.14 | 0.144 | 1.35 (0.81 - 2.24) |
| | Middle | 66 (91.7) | 6 (8.3) | | | 1 |
| Diabetes | Yes | 69 (95.8) | 3 (4.2) | 0.19 | 0.665 | 1.24 (0.45 - 3.41) |
| | No | 172 (94.5) | 10 (5.5) | | | 1 |
| Hypertension | Yes | 87 (96.7) | 3 (3.3) | 0.91 | 0.339 | 1.56 (0.57 - 4.28) |
| | No | 154 (93.9) | 10 (6.1) | | | 1 |
| UTI | Yes | 46 (100) | 0 (0) | 3.03 | 0.082 | |
| | No | 195 (93.8) | 13 (6.3) | | | |
| RTI | Yes | 24 (100) | 0 (0) | 1.43 | 0.232 | |
| | No | 217 (94.3) | 13 (5.7) | | | |

Risk factors of SSI in LSCS group

Table 21. Comparison of surgical site infections based on selected variables for LSCS

| | | Surgical Site Infections | | χ ² | p | RR (95% CI) |
|-----------------------|-----------------------|--------------------------|------------|----------------|-------|--------------------|
| | | No | Yes | | | |
| Age | <30 | 488 (83.3) | 98 (16.7) | 0 | 0.964 | 1 (0.91 - 1.11) |
| | >30 | 133 (83.1) | 27 (16.9) | | | 1 |
| Education | Upto Middle school | 384 (79) | 102 (21) | 17.9** | 0.000 | 1 |
| | High school and above | 237 (91.2) | 23 (8.8) | | | 2.07 (1.41 - 3.04) |
| Socio economic status | Lower | 344 (77.1) | 102 (22.9) | 29.72** | 0.000 | 1 |
| | Middle | 277 (92.3) | 23 (7.7) | | | 2.42 (1.66 - 3.54) |
| Name of Surgery | Elective CS | 161 (88.5) | 21 (11.5) | 4.7* | 0.030 | 1.54 (1.02 - 2.33) |
| | Emergency LSCS | 460 (81.6) | 104 (18.4) | | | 1 |
| Diabetes | Yes | 156 (71.6) | 62 (28.4) | 30.15** | 0.000 | 1 |
| | No | 465 (88.1) | 63 (11.9) | | | 1.49 (1.24 - 1.78) |
| Hypertension | Yes | 219 (80.5) | 53 (19.5) | 2.29 | 0.131 | 1 |
| | No | 402 (84.8) | 72 (15.2) | | | 1.12 (0.96 - 1.32) |
| UTI | Yes | 112 (73.2) | 41 (26.8) | 13.91** | 0.000 | 1 |
| | No | 509 (85.8) | 84 (14.2) | | | 1.22 (1.07 - 1.39) |
| RTI | Yes | 89 (83.2) | 18 (16.8) | 0 | 0.984 | 1 |
| | No | 532 (83.3) | 107 (16.7) | | | 1 (0.92 - 1.08) |
| PROM>12Hrs | Yes | 116 (77.3) | 34 (22.7) | 4.7* | 0.030 | 1 |
| | No | 505 (84.7) | 91 (15.3) | | | 1.12 (1 - 1.25) |

** : - Significant at 0.01 level, * : - Significant at 0.05 level

Table 22. Independent predictors of surgical site infection based on selected variables for LSCS (Multiple logistic regression)

| | | B | SE | p | Odds (95% CI) |
|-------------------------------------|--------------------|------|------|-------|--------------------|
| Education (High school and above ®) | Upto Middle school | 0.73 | 0.26 | 0.005 | 2.08 (1.25 - 3.48) |
| Socio economic status (Middle ®) | Lower | 1.13 | 0.26 | 0.000 | 3.1 (1.86 - 5.16) |
| Diabetes (No ®) | Yes | 1.15 | 0.21 | 0.000 | 3.15 (2.08 - 4.75) |
| PROM>12Hrs (No ®) | Yes | 0.57 | 0.24 | 0.017 | 1.78 (1.11 - 2.84) |

DISCUSSION

In the present study, 1000 cases who had undergone abdominal surgeries were studied. Of this 746 (74.6%) cases were Cesarean sections, 164 cases (16.4%) were hysterectomies and 90 cases (9%) were other laparotomies. Of the 746 cases of LSCS, 564 (76%) were emergency cesarean sections and 182 (24%) were elective CS.

Surgical site infection occurred in 138 cases (13.8%) of which 125 (90.6%) were in LSCS wounds and 13 (9.4 %) were in laparotomy wounds. This corresponds with the SSI rate of abdominal surgeries in a study conducted in a tertiary care centre by Dr, Upendranath et al^[3]

When considering the background characteristics of the study population 569 cases (56.9%) were in the age group 21 to 30 years. Age group differs in CS and hysterectomy /laparotomy group. Majority of the cases were Cesarean sections hence a large number of them were in this age group.

Considering the education status 565 cases (56.5%) had middle school education and 286 cases (28.6%) had high school education.

Regarding the socio economic status 628 cases (62.8%) belonged to the low socio economic group and 345 cases (34.5%) belonged to the upper socio economic group. Studies by Margaret A. Olsen, James Higham-Kessler, also clearly shows a rise in SSI in the lower socioeconomic group^[4]

While considering the multiple risk factors in the study group 290 cases (29%) had diabetes mellitus, 362 cases (36.2%) had hypertension , 178 (17.8%) had hypothyroidism. 199(19.9%) had history of urinary tract infections and 131(13.1%) had respiratory tract infections.

Out of the 1000 cases, 195(19.5%) had fever and only 2 cases (0.2%) had evidence of peritonitis.

Considering the LSCS group, 150 out of 746 cases (20%) had history of premature rupture of membranes lasting more than 12 hours duration. There is an increased risk of SSI as the duration of surgery exceeded more than 45 minutes in LSCS. But there is no significant difference noted in laparotomies when duration was more than 1.50 hours. This may be due to less number of cases. Studies done by Leong G1, Wilson J, Charlett also prove that duration of surgery is directly proportional to SSI^[5]

SSI was diagnosed if any one of the criteria was present – localized swelling/edema at wound / redness, or discharge from the wound or positive organisms in the culture report.

Of the 138 cases of SSI, 103 (74.6 %) had discharge from the wound, 79 (57.2%) had redness , 56 (40.6%) had positive culture report and 32(23.2%) had edema only.

Among 103 cases of discharge sent for culture and sensitivity only 54 cases (52%) yielded positive culture report .Studies conducted by Filbert J Mpogoro,1 Stephen E Mshana, also yielded only 48% culture positive cases^[6]

Of the 54 cases, 23(42.6%) cases were *Klebsiella Species*, 20 (37%) were *Staphylococcus aureus* ,9(16.7%) cases were *MRSA* and 2 (3.7%) cases were *E coli*. The most common organism causing SSI in abdominal surgeries is usually *E.coli* . In studies conducted by Stephen Mshana Mariam, MMirambo Filbert -*Klebsiellaspp* was the most common isolate from abdominal surgeries^[7]

All the isolates of *Staphylococcus aureus*, were resistant to Penicillin and sensitive to Cloxacillin and Amikacin.

All *MRSA* isolates were sensitive to Vancomycin, Amikacin and Linezolid.

All isolates of *Ecoli*, were resistant to Ampicillin but sensitive to all Aminoglycosides and Cephalosporins.

Risk factor analysis-

Bivariate analysis done to study the risk factors of SSI .

Age

Age group divided in to <30 years ,>30 Years. Of the two groups 16.2% had SSI in the age group < 30 years which is statistically significant. This may be due to the fact that majority of the study group were cesarean sections which were in the age group of < 30 Years and number of SSI are more in the LSCS cases.

Education status

When the education status is concerned, only 8.2% SSI in those who had high school education or more and 17% cases of SSI in middle school education or less. This shows a statistical significance and Odds ratio 2.29 and there is 2 times increased risk of SSI.

Socio economic status

When the socio economic status is taken 17.4 % cases of SSI in the low socio economic group whereas only 7.8% cases of SSI in middle and high socio economic group which is statistically significant (odds ratio -2.63). This can be explained by the hygienic care which is more in these groups.

Type of cases

When considering emergency and elective cases there is an increased risk of SSI- 17% in emergency cases compared to 14% in elective cases which is statistically significant.

Pre existing Diabetes

A significant association is also noted in Diabetes -22% cases had SSI in Diabetes and 10.3% in nondiabetics.

Hypertension and Hypothyroidism

There is no significant association in hypertension and hypothyroidism and SSI.

Urinary tract infection

There is significant association with history of urinary tract infections-20.6% cases had SSI vs 12.1% who had no history of UTI.

Duration of surgery

When taken the duration of surgery as the risk factor there is an increased risk of SSI as the duration of surgery was exceeded to more than 45 minutes in LSCS - 15.8% vs 10.7% (odds ratio 1.56). There is no significant association noted in laparotomies when duration is more than 1.30.hours. Though there is a slight increase in SSI noted in cases where the duration exceeded to more than 1.5 hrs(13.8% vs 10.5%) this is not statistically significant. This may be due to the fact that the number of cases were less.

Thus Bivariate analysis showed Age, educational status, Socio economic status, type of surgery (emergency vs elective),pre existing Diabetes, UTI are significant risk factors for Surgical Site Infections in Abdominal surgeries.

Multivariate analysis showed socio economic status, education status and Diabetes are independent risk factors for Surgical Site Infections in Abdominal surgeries.

Separate analysis in both groups

As the risk factors in LSCS and Laparotomy vary they were analysed separately for these groups.

Bivariate analysis of the risk factors in LSCS group-

There is no significant difference in Surgical site infection in the age group <30 years and >30 years.

Educational status, Socioeconomic status, type of surgery (emergency vs elective),pre existing Diabetes, UTI,PROM>12hoursare significant risk factors for surgical site infection in LSCS group.

Multi variate analysis showed socio economic status, educationstatus, Diabetes and PROM>12

hours are the independent risk factors for surgical site infections in LSCS.

When the laparotomy group was studied no significant difference was demonstrated for the selected variables studied. This may be due to the small number of cases in Laparotomy group.

CONCLUSION

Of the 1000 cases studied, 13.8% is the hospital incidence of surgical site infection following major abdominal gynecologic surgeries

The incidence of SSI in caesarean cases were more than hysterectomy/laparotomy group.

Of the total SSI cases which were culture positive, *Klebsiella species* and *Staphylococcus aureus* were the major isolates, remaining were *MRSA* and *E.coli*

Among the risk factors studied low socio economic status, low education status, diabetes mellitus, emergency cases , cases with history of urinary tract infections and duration of surgery showed significant increased association to the risk of surgical site infections in major abdominal surgeries.

As the risk factors in LSCS and laparotomy vary, they were analyzed separately for these groups.

Educational status, socio economic status, type of surgery (emergency vs elective), pre existing diabetes, UTI, PROM > 12 hours are significant risk factors for surgical site infection in LSCS group.

When we go through the laparotomy group alone no significant difference was demonstrated for the selected variables studied. This may be due to the small number of cases in Laparotomy group.

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