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Original Research Article

Observational study of post operative wound infections risk factors

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Abstract

Aim and Objectives: To survey and critically analyse the number and cause of surgical site infections post cesarean sections in my hospital for a period of 1 year and to provide data to aid in formulating recommendations to reduce their incidence. To assess the incidence of SSIs after cesarean sections and to explore causative and risk factors. To identify the common causative pathogens and their antibiotic sensitivity profile.

Methods: The study was a cross sectional observational study conducted in a tertiary care teaching hospital between July 2020 and June 2021 with sample size of 305 post operative patients after a cesarean section. Nature of wound complication and the postoperative day of occurrence of complication was noted. Baseline and special investigations like wound swab for culture and sensitivity were sent. The patients were followed through daily dressing and wound fortification techniques used were noted. The duration of hospital stays, and status of repaired wound were noted.

Results: The incidence of wound infection in our present study was 10.1%. The present study shows that Obesity, Anemia, Diabetes, HTN are associated with higher incidence of wound infections. The present study shows that PROM is associated with increased number of wound infections. The use of non-absorbable sutures like nylon and prolene instead of absorbable sutures like vicryl didn't reduce the incidence of wound infections. Most of the wound infections occurred on 4^{th} and 5^{th} postoperative day. Most cases of wound infections occurred in cases operated for previous LSCS. Secondary suturing along with higher antibiotics proved to be effective in treating wound infections. 99% of cases with wound infections after treatment had well healed wounds.

Conclusions: The most common organism isolated was Pseudomonas followed by Klebsiella. The organisms are most sensitive to Piperacillin and tazobactam followed by Amoxyclav. Strategies for prevention of SSI must aim to correct anemia prior to delivery, avoid prolonged hospital stay prior to delivery, to correct maternal comorbidities prior to surgery and strict adoption of asepsis. Higher antibiotics should be started preoperatively for PROM cases. SSI surveillance must be done as a part of healthcare associated infections audit which aims at improving quality control measures and infection control practices.

Keywords: Cesarean Section, Surgical Site Infections, Post Cesarean Complications, Post Operative wound infection, Surgical Asepsis

Introduction

Cesarean section is a major obstetrical surgical procedure aiming to save the lives of mothers and fetuses. The incidence of cesarean deliveries, both primary and repeat, has risen dramatically over the last few decades, with an incidence of 7% in 1990 to 21% today, and are projected to continue increasing over this current decade [1]. As a surgical procedure, cesarean section may be accompanied by several complications: surgical site infection (SSI)

ISSN 2515-8260 Volume 10, Issue 03, 2023

being one of them. The rate of SSI ranges from 3% to 15% worldwide[2].The variation in incidence may reflect differences in population characteristics and risk factors, perioperative practices, and the duration from the procedure until assessment. In this day of aseptic surgery with vigorous preoperative preparation of surgical field and antibiotic prophylaxis and postoperative care, the incidence of wound complications has decreased significantly. Despite this decrease, the occurrence of wound complications is expected to increase, given the continuous rise in incidence of cesarean sections.

Postoperative wound complications may increase maternal morbidity and mortality. It delays recovery and often increases the length of stay in hospital and require extra resources for investigations, management and nursing care and increases the risk of hospital acquired infections. It may increase health care costs and lead to other socioeconomic implications. In addition, surgical site infection can be frustrating for the mother trying to recover from the procedure and at the same time take care of the newborn. Most tertiary care centres have developed their own surgical antibiotic prophylaxis protocol based on the identified causative micro-organisms of Surgical Site Infections (SSI). Reduction in postoperative wound infection is related to increased education and awareness of its causes and its prevention is aided by critically evaluated infection control practice. Our hospital is the only tertiary care referral hospital for 3 districts and caters to a population of 10 million. This study helps to find incidence of wound infection and analyse risk factors, common bacterial pathogens, and antibiotic sensitivity.

Methodology

The study was a cross sectional observational study conducted in a tertiary care teaching hospital between July 2020 and June 2021 with sample size of 305 post operative patients after a cesarean section.

Inclusion criteria

- Patients of age 18-40 who underwent caesarean section within the hospital.
- Complication defined as an event that has modified the course of postoperative period.
- Time interval for the occurrence of complications between 0-42 days from the date of surgery
- Patients who gave valid consent

Exclusion criteria

- Time interval more than 42 days from the date of surgery
- Other complications presenting independently like febrile morbidity, peritonitis, endometritis, sepsis etc.
- Patients who did not give valid consent.

This is an observational study of all patients who were operated in our hospital for any obstetric cause during the study period. All the women who were operated were observed for development of any wound complications during their stay in the hospital and the following data was collected after obtaining written and informed consent.

- A detailed history with full details regarding age, parity, nutritional status, diet, socioeconomic status, antenatal checkups, past history, h/o medical illnesses complicating pregnancy etc.
- A thorough clinical examination for pallor if present, BMI, systemic examination to look for factors contributing to wound complications etc.
- Details of labor
- Details of cesarean section
- Details of Postoperative period
- Nature of wound complication and the postoperative day of occurrence of complication

ISSN 2515-8260 Volume 10, Issue 03, 2023

was noted.
- Baseline and special investigations like wound swab for culture and sensitivity were sent.
- The patients were followed through daily dressing and wound fortification techniques used were noted.
- The duration of hospital stays, and status of repaired wound were noted.

Statistical methods

All the raw data was subsequently entered into a Microsoft Excel spreadsheet and analyzed using IBM SPSS Software, Version 21.

Frequencies, percentages, means, medians, and 95% confidence intervals were calculated to evaluate distribution of cases.

Ethical considerations

- Prior permission was taken from Institutional Ethics Committee, Andhra Medical College, Visakhapatnam.
- A Written informed consent was taken from each individual of the study.

Observations and results

Table 1: Incidence of postoperative wound complications

Postoperative wound complications	Frequency	Percent (%)
Yes	305	10.1
No	2713	89.9
Total number of cases	3018	100.0

This table and figure show the incidence of postoperative wound complications in our study. Of the total 3018 cases, 305 developed wound complications postoperatively. The incidence of wound complications in our study was 10.1%

Table 2: Age distribution of cases with postoperative wound complications

Age in years	Number of cases	Percent (%)
18-20	59	19.3
21-25	127	41.6
26-30	90	29.5
>30	29	9.5
Total	305	100.0

This table and figure show the distribution of cases according to their age. Most of the patients in our study were in the age group of 21-25 yrs accounting to 41.6%, and 29.5% of the patients were between 26-30 yrs. 19.3% of the patients were between 18-20 yrs and 9.5% of them were more than 30 yrs age.

Table 3: BMI distribution of cases

BMI	Number of cases	Percent (%)
Underweight	18	5.9
Normal	189	62.0
Overweight	61	20.0
Obese	37	12.1
Total	305	100.0

This table shows the Body Mass Index of the cases studied. BMI is calculated using the formula BMI=Weight in Kg/Height in m^2. 62% of cases had appropriate BMI, and 32.1% cases were above normal BMI.

ISSN 2515-8260 Volume 10, Issue 03, 2023

Table 4: Distribution of cases according to parity

Parity	Number of cases	Percent (%)
Multi	200	65.6
Primi	105	34.4
Total	305	100.0

This table shows the distribution of primi and multi cases with postoperative wound complications. In our study maximum wound complications occurred in the multi group i.e. 200 out of 305 accounting to 65.6%, and 34.4% of wound complications occurred in primi cases.

Table 5: Elective and emergency

Nature of LSCS	Number of cases	Percent (%)
Elective	70	23.0
Emergency	235	77.0
Total	305	100.0

This table shows distribution of the Elective and Emergency cases with postoperative wound complications. In our study maximum wound complications occurred in the emergency group. The Emergency group contributed to 77% of cases with wound complications and Elective group contributed to 23% of cases with wound infections.

Table 6: Primary and repeat lscs

Type of LSCS	Number of cases	Percent (%)
Primary	124	40.7
Repeat	181	59.3
Total	305	100.0

This table shows the distribution of primary and repeat LSCS cases with postoperative wound complications. In our study 59.3% of the cases with wound infections were of repeat LSCS group. Primary LSCS group contributed to 40.7% of cases with wound infections.

Table 7: Incidence of different types of wound complications

Types of wound complications	Number of cases	Percent (%)
Wound discharge	117	38.4
Wound gaping	188	61.6
Total	305	100.0

The types of wound complications in our study are wound discharge and wound gaping. All of those are superficial wound infections. The incidence of wound gaping in our study was 61.6% which was the most common type of wound infection encountered. The incidence of wound discharge was 38.4%.

Table 8: Wound complication rate with different types of skin incision

Type of incision	Number of cases	Percent (%)
Pfannensteil incision	298	97.7
Sub umbilical midline incision	7	2.3
Total	305	100.0

This table shows distribution of wound infections with different types of skin incision. In our study, most of the wound complications occurred with Pfannenstiel incision, probably

ISSN 2515-8260 Volume 10, Issue 03, 2023

because it was the most commonly and widely used incision for majority of the cases. And in these cases, other predisposing factors were also operational in the occurrence of wound complications. 97.7% of cases with wound infections had Pfannenstiel incision, while 2.3% cases had sub umbilical midline incision.

Table 9: Indications of lscs

Indication	Number of cases	Percent (%)
Abruption	3	1.0
Breech	13	4.3
Cephalopelvic disproportion	15	4.9
Eclampsia/ Unfavorable Cx	7	2.3
Fetal distress	16	5.2
Failed induction	15	4.9
Intra uterine growth restriction	9	3.0
Obstructed labour	11	3.6
Oligohydramnios	16	5.2
Post caesarean pregnancy	175	57.4
Placenta Previa	10	3.3
Transverse lie	9	3.0
Twins	6	2.0
Total	305	100.0

This table shows distribution of cases with wound complications with respect to indication of LSCS. Previous LSCS was the most common indication contributing to 57.4% of wound infections, followed by fetal distress and oligohydramnios contributing to 5.2% of wound infections each. Failed induction and CPD contributed to 4.9% of wound infections each.

Table 10: Use of pre-operative antibiotics

Pre-op Antibiotic	Number of cases	Percent (%)
Ceftriaxone	294	96.4
Piperacillin, Tazobactam	11	3.6
Total	305	100.0

This table shows the distribution of cases with wound infection regarding pre-operative antibiotics used. In our hospital Inj.Ceftriaxone is the most used antibiotic pre-operatively. In 96.4% of cases with wound infections, Inj.Ceftriaxone was given preoperatively, and in 3.6% cases with wound infections, Inj. Pipzo was given preoperatively.

Table 11: Technique of skin closure

Skin closure	Number of cases	Percent (%)
Mattress sutures	42	13.8
Subcuticular sutures	263	86.2
Total	305	100.0

In our study 86.2% of cases with wound complications were closed subcuticularly, and 13.8% of cases with wound infections were closed with mattress sutures. In our hospital subcuticular sutures are the most used for skin closure.

Table 12: Suture material used

Suture material	Number of cases	Percent (%)
Nylon	56	18.4
Prolene	134	43.9
Vicryl	115	37.7
Total	305	100.0

ISSN 2515-8260 Volume 10, Issue 03, 2023

This table shows occurrence of wound complications with different types of suture material used. In our study, use of prolene for skin closure contributed to 43.9% of cases with wound infections.37.7% of cases with wound infections were associated with vicryl. In our hospital synthetic non absorbable suture materials are most commonly used for skin closure.

Table 13: Post op antibiotics

Post-op antibiotics	Number of cases	Percent (%)
Ceftriaxone, Metrogyl	288	94.4
Cefperazone, Metrogyl	6	2.0
Piperacillin, Tazobactam, Metrogyl	11	3.6
Total	305	100.0

This table shows the occurrence of wound complications and the postop antibiotics used. In our hospital, inj ceftriaxone and inj metrogyl are the most commonly used antibiotics. In our study, inj ceftriaxone and inj metrogyl usage was associated with 94.4% of wound infection cases.

Table 14: Anemia in my study subjects

Anemia	Number of cases	Percent (%)
Yes	135	44.3
No	170	55.7
Total	305	100.0

In our study 44.3% of cases with wound infections had anaemia, while 55.7% of cases were not anemic**.**

Table 15: Haemoglobin status

HB	Number of cases	Percent
5.1-8.0	119	39.0
8.1-10.0	18	5.9
10.1-13.0	168	55.1
Total	305	100.0

Among 44.3% of wound infection cases with anemia, 39% of cases had Hb levels between 5.1-8.0 gm. And 5.9% cases had Hb between 8.1-10.0 gm%

Table 16: Hypertension status of study subjects

GHTN	Number of cases	Percent (%)
Yes	72	23.6
No	233	76.4
Total	305	100.0

In our study, Hypertension contributed to 76.4% of cases with wound infections.

Table 17: Diabetes mellitus status

DM	Number of cases	Percent (%)
Yes	77	25.2
No	228	74.8
Total	305	100.0

In our study, diabetes mellitus contributed to 25.2% of cases with wound infections.

ISSN 2515-8260 Volume 10, Issue 03, 2023

Table 18: Premature rupture of membranes (PROM) status

PROM	Number of cases	Percent (%)
Yes	145	47.5
No	160	52.5
Total	305	100.0

In our study, PROM contributed to 47.5% of cases with wound complications.

Table 19: Day of suture removal

Day of SR	Number of cases	Percent (%)
6^{th} day	262	85.9
7^{th} day	36	11.8
9^{th} day	7	2.3
Total	305	100.0

In our hospital, suture removal is done most commonly on POD-6. In our study 85.9% of cases with wound infections had their suture removal on 6^{th} postoperative day, while 11.8% of cases with wound infections had suture removal on 7^{th} postoperative day. And 2.3% cases had suture removal on 11^{th} POD

Table 20: Post operative day of occurrence of wound complication.

Day of occurrence of complication	Number of cases	Percent (%)
POD 4	130	42.6
POD 5	175	57.4
Total	305	100.0

In our study, all cases had postoperative wound infections on either 4^{th} or 5^{th} postoperative day.57.4% of cases were found to have wound complications on 5^{th} postoperative day.

Table 21: Organisms isolated.

Organism	Number of cases	Percent (%)
E. Coli	33	10.8
Klebsiella	74	24.3
MRSA	2	0.7
Proteus	25	8.2
Pseudomonas	108	35.4
S. Aureus	41	13.4
No organism	22	7.2
Total	305	100.0

In our study, the most commonly isolated organism was pseudomonas contributing to 35.4% of wound infections, followed by klebsiella contributing to 24.3% of cases.

Table 22: Treatment of wound infection

Treatment	Number of cases	Percent (%)
Higher antibiotics	117	38.4
Secondary suturing + Higher antibiotics	188	61.6
Total	305	100.0

In our study, among those patients developed wound infections, 61.6% of patients undergone secondary suturing and 38.4% of patients responded to higher antibiotics and local wound care.

ISSN 2515-8260 Volume 10, Issue 03, 2023

Table 23: Duration of hospital stay

Days of hospital stay	Number of cases	Percent (%)
1 to 10	55	18.0
11 to 20	248	81.3
21 to 30	2	0.7
Total	305	100.0

Wound infection leads to significant extension of hospital stay.82% of patients with wound infections stayed for more than 10 days in the hospital.

Table 24: Outcome of wound infection

Outcome	Number of cases	Percent (%)
Repeat gaping	3	1.0
Wound healed	302	99.0
Total	305	100.0

In our present study 99% of cases had well healed wounds and only 1% of cases developed repeat gaping

Table 25: Antibiotic sensitivity

Antibiotic	Number of cases	Percent (%)
Augmentin	59	19.3
Gentamycin	48	15.7
Piperacillin, Tazobactam	121	39.7
Ciprofloxacin	6	2.0
Amikacin	51	16.7
Sulbactam	15	4.9
Clindamycin	15	4.9
Cefperazone	44	14.4
Clarithromycin	5	1.6
Meropenem	41	13.4
Ofloxacin	21	6.9

In the present study, organisms are most sensitive to inj piperacillin plus tazobactum.39.7% of cases are sensitive to inj pipzo,and 19.3% are sensitive to inj augmentin

Table 26: Statistics

	Age	Duration of surgery	Day of SR	Day of wound inf	Duration of stay	Hb
Mean	24.47	55.98	6.19	4.57	13.25	9.883
Median	24.00	60.00	6.00	5.00	14.00	11.000
Std. Deviation	4.051	12.902	.539	.495	2.440	2.1459
Minimum	18	40	6	4	9	5.6
Maximum	34	110	9	5	24	13.0

ISSN 2515-8260 Volume 10, Issue 03, 2023

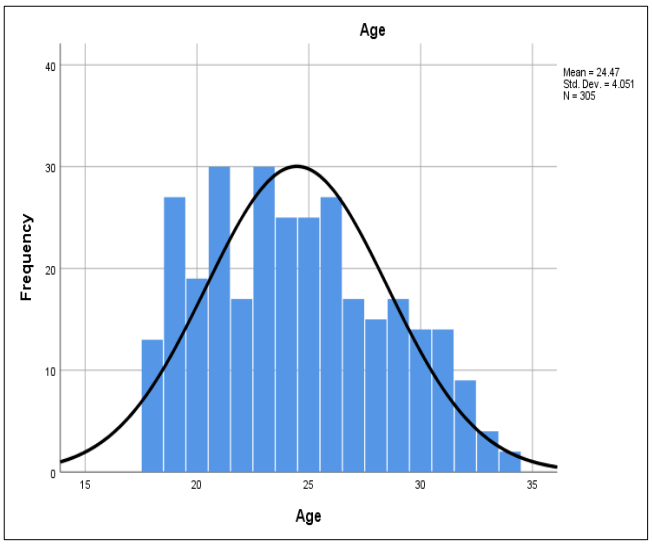

Fig 1: Age frequency

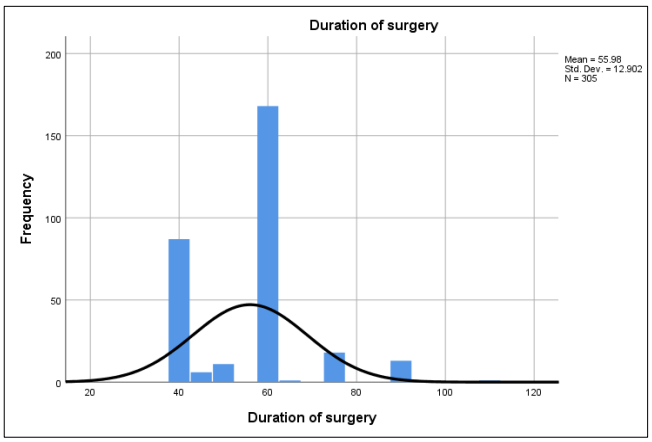

Fig 2: Duration of surgery

Mean duration of surgery is around one hour (60 min)

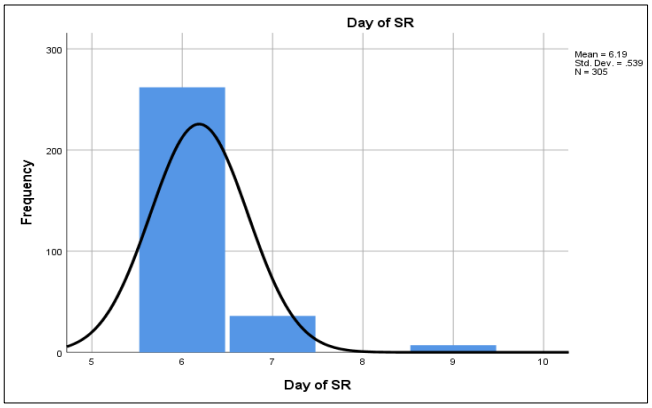

Fig 3: Frequency of day of SR

ISSN 2515-8260 Volume 10, Issue 03, 2023

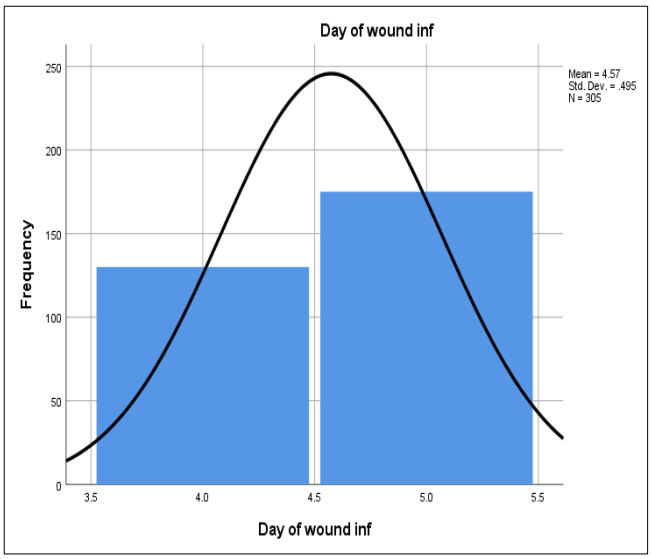

Fig 4: Day of wound infection

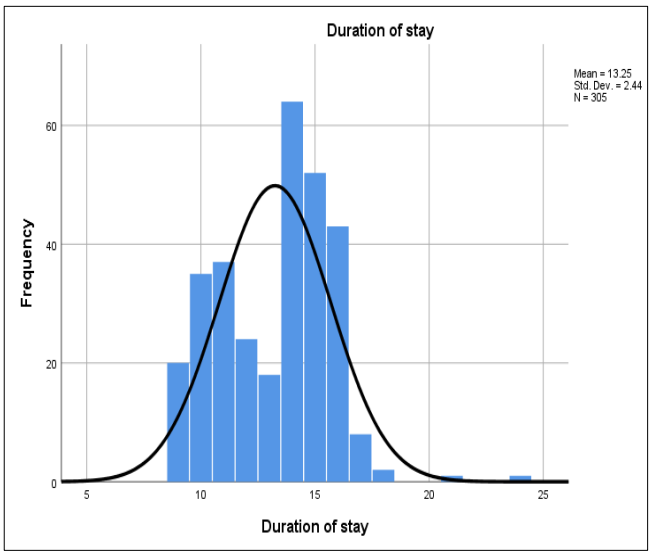

Fig 5: Duration of stay

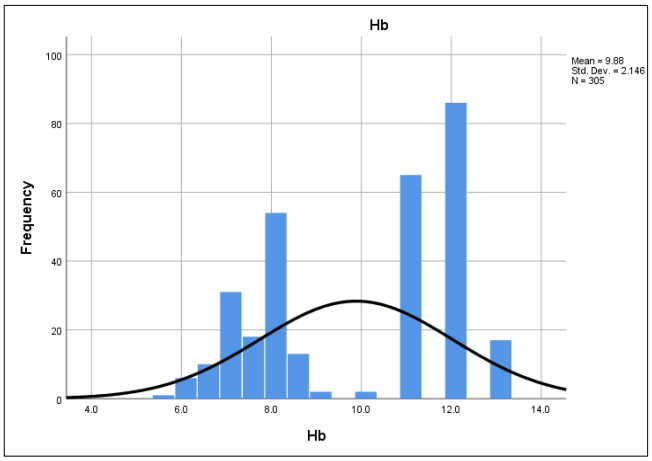

Fig 6: Hb distribution

Discussion

The present study was done at King George Hospital, Visakhapatnam during the period of July 2020 to June 2021.During the study period,3018 patients underwent Emergency and Elective cesarean sections. Out of those patients,305 developed wound complications.

ISSN 2515-8260 Volume 10, Issue 03, 2023

The wound infection rates vary from 0.5-15% in review of literature, the incidence of wound infection in the present study was 10.1%.The study conducted by Zejnullahu *et al*, (2019) [3] showed incidence of 9.85%.The study conducted by Laura J. Moulton *et al*, (2017) [4] in U.S.A showed incidence of 5.5%.In a study conducted at a Jordanian teaching hospital by Mariam *et al* (2017) [5], the incidence was found to be 14.4%.In a study conducted by Simon M. Scheck *et al* (2017) [6], the incidence was 5.2% which included 2231 subjects.

Table 27: Incidence of wound infections in various studies

S. No	Study of SSI	SSI Incidence
1	Present study	10.1%
2	Zejnullahu *et al*, (2019) [3]	9.85%
3	Laura J.Moulton(2017) [4]	5.5%
4	Simon M.Scheck *et al*, (2017) [6]	5.2%
5	Mariam *et al*, (2017) [5]	14.4%

Overall, the incidence of SSI in our current study is high, yet comparable to other studies.

Table 28: Wound infections in emergency vs elective LSCS in various studies

S. No	Study of SSI	Emergency LSCS	Elective LSCS
1	Present study	77%	23%
2	K Gomaa *et al*, (2019) [7]	81.2%	18.8%
3	T Alemye *et al*, (2021) [8]	75.9%	24.1%

In our present study, 77% of cases with wound infections had an Emergency LSCS, which are consistent with results of studies done by K Gomaa *et al* [7] and T Alemye *et al* [8].

Table 29: Comparison of SSI rate associated with anemia in various studies

S. No	Study of SSI	Anemia
1	Present study	44.3%
2	HansaDhar *et al*, (2014) [9]	17.5%
3	T Alemye *et al*, (2021) [8]	10.9%

In our present study,44.3% of cases with wound infections were anemic, which is higher compared to other studies done previously. It was probably because many patients included in the present study were of low socioeconomic status, belonging to tribal areas with poor health care facilities.

Table 30: Comparison of SSI rates associated with prom in various studies.

S. No	Study of SSI	Prom
1	Present study	47.5%
2	K Gomaa *et al* (2019)	43.6%
3	HansaDhar *et al* (2014) [9]	17.5%

In our present study,47.5% of cases with wound infections had PROM. It is comparable with the results of study done by K Gomaa *et al* (2019). In the study done by HansaDhar *et al*, [9] overall incidence of wound infections is 2.66% and PROM was present in 17.5% of cases. Their study concluded that PROM increases the risk of wound infections by 4 fold.

ISSN 2515-8260 Volume 10, Issue 03, 2023

Table 31: Comparison of SSI rates associated with obesity in various studies.

S. No	Study of SSI	Obesity
1	Present study	12.1%
2	K Gomaa *et al* (2019) [7]	16.4%
3	HansaDhar *et al* (2014) [9]	8.53%

In our present study, 12.1% of cases with wound infection were obese with BMI more than or equal to 30kg/m², which are comparable with results of other studies. The study conducted by HansaDhar *et al* (2014) found that obesity increases the risk of wound infections by 3 times.

Table 32: Comparison of SSI rates with diabetes in various studies

S. No	Study of SSI	Diabetes
1	Present study	25.2%
2	K Gomaa *et al* (2019) [7]	10.0%
3	HansaDhar *et al* (2014) [9]	15%

In our present study, 25.2% of cases with wound infections had diabetes, which is higher compared to results of other studies. This may be due to the presence of multiple risk factors in some patients. According to study conducted by HansaDhar *et al* (2014), Diabetes increases the risk of wound infection by 3 times.

Table 33: Comparison of SSI rates with HTN in various studies

S. No	Study of SSI	GHTN/HTN
1	Present study	23.6%
2	HansaDhar *et al* (2014) [9]	9.47%

In our present study,23.6% of cases with wound infections were hypertensive, which is higher than results of study done by HansaDhar *et al*. This may be due to less sample size in the study conducted by HansaDhar *et al* (2014). Their study concluded that HTN increases the risk of wound infections by 3 times.

Table 34: Most common organism isolated in various studies.

S. No	Study of SSI	Organism
1	Present study	Pseudomonas aureginosa
2	Zejnullahu *et al*, (2019) [3]	Staphylococcus Aureus
3	Mariam *et al*, (2017) [5]	Staphylococcus Aureus
4	HansaDhar *et al*, (2014)	Staphylococcus Aureus
5	Amrita R *et al*, (2013)[10]	E.coli

In our present study the most common organism isolated in pus culture was Pseudomonas followed by Klebsiella. Where as in three other studies done by Zejnullahu *et al*, Mariam *et al* and HansaDhar *et al*, the most common organism was Staphylococcus aureus. In a study done by Amrita R *et al* E.coli was the most commonly isolated organism.

Table 35: Antibiotic sensitivity in various studies

S. No	Study of SSI	Antibiotic
1	Present study	Piperacillin, tazobactum
2	HansaDhar *et al*, (2014) [9]	Gentamycin
3	Amrita R *et al*, (2013)	Amoxyclav

In our present study, organisms were most sensitive to piperacillin and tazobactam. In the study done by Hansa Dhar *et al*, S. Aureus was found to be sensitive to Gentamycin. In the

ISSN 2515-8260 Volume 10, Issue 03, 2023

study done by Amrita R *et al*, sensitivity for Amoxyclav was more. The organism isolated and antibiotic sensitivity spectrum is different from present study and other studies probably because of change in place of study and increasing antibiotic resistance through the years.

In our present study all the wound infection are superficial SSI's. There were no Deep Incisional or Organ/Space SSI. The median time to occurrence of wound infection was 5th POD in our present study and in a study done by Zejnullahu *et al* (2019) [3], the median time to SSI was 7th postoperative day.

In our present study 57.4% of wound infections occured in patients with previous cesarean section. In the study conducted by Zejnullahu *et al* (2019) [3], it was confirmed that patients with a history of previous cesarean section were 7.4 times more likely to develop SSI. In the present study 61.6% of patients underwent secondary wound resuturing, while the others were treated with local wound care and higher antibiotics. In our present study,82% of patients had to stay in the hospital for more than 10 days.In a similar study conducted by T Almeye *et al* (2021),47.8% of patients with wound infections had more than 7 day hospital stay. Wound infection leads to significant extension of hospital stay.

Conclusion

- Caesarean section is one of the most common surgical procedures done around the world and its incidence has risen over the last few decades. Wound infection after cesarean section is a major cause of prolonged hospital stay. It increases maternal morbity, leads to increased health care costs and poses a significant burden to health care system
- C-section is a clean contaminated type of surgery, so procedure related chance of infection is less. Hence proper assessment of risk factors that predisposes to SSI is important for developing preventive strategies.
- The incidence of wound infection in our present study was 10.1%
- The present study shows that Obesity, Anemia, Diabetes, HTN are associated with higher incidence of wound infections. The present study shows that PROM is associated with increased number of wound infections.
- The use of non-absorbable sutures like nylon and prolene instead of absorbable sutures like vicryl didn't reduce the incidence of wound infections.
- Most of the wound infections occurred on 4th and 5th postoperative day.
- Most cases of wound infections occurred in cases operated for previous LSCS.
- Secondary suturing along with higher antibiotics proved to be effective in treating wound infections.
- 99% of cases with wound infections after treatment had well healed wounds.
- The most common organism isolated was Pseudomonas followed by Klebsiella.
- The organisms are most sensitive to Piperacillin and tazobactam followed by Amoxyclav.
- Strategies for prevention of SSI must aim to correct anemia prior to delivery, avoid prolonged hospital stay prior to delivery, to correct maternal comorbidities prior to surgery and strict adoption of asepsis.
- Higher antibiotics should be started preoperatively for PROM cases.
- SSI surveillance must be done as a part of healthcare associated infections audit which aims at improving quality control measures and infection control practices.

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