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Original Research Article

Surgical Site Infections Before and During COVID-19 Pandemic: A Comparative Clinico-Pathological and Bacteriological Study of 100 Cases Each in a Tertiary Health Care

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Conflict of interest: Nil

Abstract:

Background: Post-operative wound infection rate varies from 1 – 9%, depending on several factors like microbial pathogenicity, host defenses (age, sex, nutrition, immunity, antibiotics use), local environment factors, razor use for hair removal before surgery and surgical techniques.

Aim and Objective: This cross sectional study was done to find out the incidence of SSIs and factors influencing its development, types of common bacterial pathogen causing SSIs and their sensitivity in post-operative period before (i.e. July 2019 – February 2020) and during(i.e. March 2020 – October 2020) COVID-19 Pandemic period in Department of General Surgery, Veer SurendraSai Institute of Medical Science And Research (VIMSAR), Burla, Sambalpur, Odisha.

Methods and Material: Patients enrolled in this study were divided into 2- groups of 100 cases each.

A. Pre-pandemic group (Group-1)

B. Pandemic group (Group-2),

were reviewed during our sixteen months study period to know the incidence of SSIs and factors influencing SSIs. Parameters studied were patient's age, BMI, blood sugar profile, haemoglobin, bacteriological profile, type and duration of surgery, antibiotics prophylaxis, duration of pre-op stay, and antibiotic sensitivity pattern of the cultured organism.

Results: Overall SSIs incidence rate in Pre-pandemic and Pandemic period were 26% and 36% respectively. The higher incidence of SSIs in in this study was multifactorial. Staphylococcus aureus and E. coli remain the major culprit in SSIs in Pre-pandemic and Pandemic period respectively.

Conclusions: Overall SSIs incidence rate in Pandemic period was higher than Pre-pandemic period, which may be due to delayed presentation in casualty department resulting delayed diagnosis and advanced stage of the disease. So, identification of common pathogens and use of specific antibiotics after institutional SSI surveillance is required for controlling post-op wound infections.

Keywords: Surgical site infection, Pandemic period, Pre-pandemic period.

Introduction

Wuhan (in China), from where Coronavirus disease (COVID-19) started in December 2019 leading to severe acute respiratory syndrome, became epidemic. Later on it was declared as pandemic by WHO (World Health Organisation) on 11th March 2020 [1]. Due to implementation of luckdown phase in national level, both emergency and elective care has been reduced to only those come with acute emergency resulting delayed presentation and advanced stage of the disease. Post-operative wound infection rate varies from 1 – 9%, depending on several factors like microbial pathogenicity, host defenses (age, sex, nutrition, immunity, antibiotics use), local environment factors, razor use for hair removal before surgery (type of shaving) and surgical techniques (type of operation and duration) [2,3]. Staphylococcus aureus, itself comprises 15-20% of these infections [4]. Surgical site infections (SSIs)account 3rd most frequent nosocomial infections varies from 14-16% of all nosocomial infections among hospitalized patients [5]. After late 1860s, Joseph Lister introduced the 'Principle of Antisepsis' which dramatically reduces post-operative infection related morbidity and mortality [6]. Therefore, Incidence of infection α virulence of microorganism / Host body resistance × Amount of contamination [7].

According to centre for disease control's (CDC) National Nosocomial Infection Surveillance (NNIS), standardized surveillance criteria for SSIs defined as, it involves a complex relationship among microbial characteristics (e.g. degree of contamination and virulence of pathogen), patient characteristics (e.g. immune status and co-morbid conditions) and surgical characteristics (e.g. type of procedure, introduction of foreign material and amount of tissue damage).CDC also defines SSIs as an infection that occurs within 30 days of operation, but when a device (mesh) implanted, it is within 1 year of the implanted device being in place[8].

Aim and Objective

This cross sectional study was done to find out the incidence of SSIs and factors influencing its development, types of common bacterial pathogen causing SSIs and their sensitivity in post-operative period (after both emergency and elective operations) before (i.e. July 2019 – February 2020) and during(i.e. March 2020 – October 2020) COVID-19 Pandemic period in Department of General Surgery, Veer SurendraSai Institute of Medical Science And Research (VIMSAR), Burla, Sambalpur, Odisha.

Material and Method [4]

Source of Data

Patients admitted in Department of General Surgery, Veer Surendra Sai Institute of Medical Science and Research (VIMSAR), Burla, Sambalpur, Odisha, India for both elective and emergency surgeries, were reviewed during our sixteen months study period.

Study Period

From July 2019 to February 2020 (Pre-pandemic period)

From March 2020 to October 2020 (Pandemic period)

Calculated Sample Size (n)

100cases each in Pre-pandemic and Pandemic period

Inclusion Criteria

Patients aged between 15 to 80 years irrespective of sex, who were admitted for emergency or elective laparotomy in Department of General Surgery, VIMSAR, Sambalpur.

Exclusion Criteria

Age less than 15 years and more than 80 years.
Wounds which were laid open (immune-compromised patients, chronic infections e.g. gas gangrene, non-healing ulcer, diabetic ulcer)
Operation on ulcers like skin grafting
Perianal surgeries (In which post-operative contamination were imminent)
Patients with other diseases

Method of Collection of Data

Details of cases were recorded including history, clinical assessment, pre-operative investigations (CBC, random and fasting blood sugar, serum urea and creatinine, serum electrolytes). The presence of any septic focus, comorbidities, use of any drugs were determined.

Pre-operative intravenous antimicrobial prophylaxis, pre-operative skin preparation, closure of surgical incision in layers, and post-operative antibiotics were kept constant in all cases. First post-operative period examination was done after 48 hours or even earlier, if there was soakage or patient had high temperature or disproportionate pain at the site of wound, and thereafter it was done every second day or as and when needed. All case were followed till skin suture removal. Any discharge from the incision site, swab wascollected. Culture and sensitivity testing was done.

Study Design[5]

Patients enrolled in this study were divided into 2-groups of 100 cases each.
A. Pre-pandemic group (Group-1)
B. Pandemic group (Group-2)

Statistical Analysis

All groups were compared using Chi-square test and student's t test. P-value of < 0.005 indicated a statistically significant.

Ethical Approval

Taken from Departmental Institutional Ethics Committee of Veer Surendra Sai Institute of Medical Science and Research (VIMSAR), Sambalpur, Odisha before starting the study.

Funding

None funding sources.

Conflict of Interest

None declared.

Results

Table 1: Incidence rate of SSIs in relation to age (in years), BMI (in kg/m^2), Hblevel (in gm%)

Sl.no.	Age (in years)	Total patients		No. of Infections (%)	
		Pre-pandemic period	Pandemic period	Pre-pandemic period	Pandemic period
1.	< 20	11	15	02(18.11%)	04(26.67%)
2.	21 – 40	34	31	07(20.59%)	09(29.03%)
3.	41 – 60	31	29	08(25.81%)	10(34.48%)
4.	> 60	24	25	09(37.50%)	13(52%)
Total		100	100	26	36
Sl.no.	BMI (in kg/m^2)	Pre-pandemic period	Pandemic period	Pre-pandemic period	Pandemic period
1.	< 20	14	11	06(42.86%)	06 (54.54%)
2.	20.1 - 25	58	53	11(18.97%)	13(24.53%)
3.	25.1 - 30	25	27	07(28%)	10(37.04%)
4.	> 30	03	09	02(66.66%)	07 (77.77%)
Total		100	100	26	36
Sl.no.	Hb level (in gm%)	Pre-pandemic period	Pandemic period	Pre-pandemic period	Pandemic period
1.	< 9	14	11	06(42.86%)	06 (54.54%)
2.	9 - 12	56	53	15(26.79%)	20(37.74%)
3.	> 12	30	36	05 (16.67%)	10 (27.78%)
Total		100	100	26	36
Sl.no.	Fasting blood sugar (in mg/dl)	Pre-pandemic period	Pandemic period	Pre-pandemic period	Pandemic period
1.	< 140	58	48	10 (17.24%)	15(31.25%)
2.	> 140	42	52	16(38.09%)	21(40.39%)
Total		100	100	26	36

Table 1: Shows – Average incidence rate of SSIs in Pre-pandemic and Pandemic period were 26% and 36% respectively. The incidence in both groups were seen increasing with age. In other words, older patients were more commonly associated with infected wounds, i.e. lowest (18.11% and 26.67% in < 20 years age group) and highest (37.50% and 52% in > 60 years age group) in Pre-pandemic and Pandemic groups respectively. This was found to be statistically significant [X^2= 12.732(Pandemic group), X^2 = 17.985(Pre-pandemic group), p value < 0.002]. On comparison, irrespective of age groups Pandemic period was more infectious (36%). Both extremes of BMI (i.e. < 20 Kg/m^2 and > 30 Kg/m^2) were associated with higher (42.86% , 54.54% and 66.66% , 77.77%) incidence of wound infections in Pre-pandemic and Pandemic period respectively. On comparison, Pandemic period was more infectious than other in respective BMI.

In both groups, on increasing in Hemoglobin level the incidence of SSIs development were gradually decreasing (i.e. from 42.86% to 16.67% in pre-pandemic group and from 54.54% to 27.78% in pandemic group). On comparison of two groups, Pandemic period was more infectious. The association was statistically significant with X^2 = 15.542 (Pre-pandemic period), X^2 = 18.658 (Pandemic period) and p-value = < 0.001.

10/58 (17.24%) cases and 15/48 (31.25%) cases having pre-operative fasting blood sugar level < 140 mg/dl develop SSIs against 16/42 (38.09%) cases and 21/52(40.39%) cases having > 140 mg/dl in Pre-

pandemic and Pandemic period respectively. On comparison, irrespective of pre-operative fasting blood sugar level, Pandemic period was more infectious. Statistical analysis showed X^2= 9.564 (Pre-pandemic group) X^2=12.783 (Pandemic group), p-value< 0.001. So finding being statistically significant.

Table 2: Incidence of SSIs in relation to other factors[6,7,8]

		Total patients		No. of Infections (%)	
Sl.no.	**Type of wound**	**Pre-pandemic period**	**Pandemic period**	**Pre-pandemic period**	**Pandemic period**
1.	Clean	42	35	06 (14.29%)	08(22.85%)
2.	Clean contaminated	20	25	05 (25%)	08(32%)
3.	Contaminated	21	22	07 (33.33%)	10(45.45%)
4.	Dirty	17	18	08 (47.06%)	10 (55.56%)
	Total	100	100	26	36
Sl.no.	**Type of surgery**	**Pre-pandemic period**	**Pandemic period**	**Pre-pandemic period**	**Pandemic period**
1.	Elective	70	30	16(22.86%)	09(29.99%)
2.	Emergency	30	70	10(33.33%)	27(38.58%)
	Total	100	100	26	36
Sl.no.	**Pre-op-antibiotics**	**Pre-pandemic period**	**Pandemic period**	**Pre-pandemic period**	**Pandemic period**
1.	Given	70	30	15(21.43%)	09 (29.99%)
2.	Not given	30	70	11(36.67%)	27 (38.58%)
	Total	100	100	26	36
Sl.no.	**Pre-op-stay (in days)**	**Pre-pandemic period**	**Pandemic period**	**Pre-pandemic period**	**Pandemic period**
1.	< 2	25	29	5 (20%)	7 (24.14%)
2.	2 – 4	40	34	9 (22.5%)	9 (26.47%)
3.	> 4	35	37	12 (34.29%)	20 (54.06%)
	Total	100	100	26	36
Sl.no.	**Duration of surgery (In hours)**	**Pre-pandemic period**	**Pandemic period**	**Pre-pandemic period**	**Pandemic period**
1.	0 – 1	07	08	0(0)	01(12.5%)
2.	1 – 2	34	36	06(17.65%)	08(22.22%)
3.	2 – 3	32	29	08(25%)	13(44.83%)
4.	3 – 4	21	18	09(42.86%)	09 (50%)
5.	> 4	06	09	03(50%)	05(55.56%)
	Total	100	100	26	36

Table 2: Shows – There was gradual increase in SSIs with increasing contamination. On comparison to elective cases, emergency surgeries relate to higher SSIs incidence. Pre-op-antibiotics, shorter pre-op stay, and longer duration of surgery correspond to low rates of infection. Pandemic period (36%) relates to higher incidence of infection in comparison to Pre-pandemic period (26%).

The infection rate in wound were - Clean (14.29%, 22.85%), Clean contaminated (25%, 32%), Contaminated (33.33%, 45.45%), Dirty (47.06%, 55.56%) in Pre-pandemic and Pandemic period respectively. Hence bacterial contamination, and Pandemic period (comparing to Pre-pandemic) relate to incidence of infection.

The infection rates (Pre-pandemic period) in elective and emergency surgery were 22.86% and 33.33%, which comparably less than Pandemic period (29.99%, 38.58%). Hence emergency surgery relates to higher SSIs in both periods.

The infection rates with and without pre-op antibiotics (in Pre-pandemic period) were 21.43% and 36.67%, which comparably less than Pandemic period (29.99%, 38.58%). Hence surgery without pre-op antibiotics were relates to higher SSIs in both periods.

The incidence of SSIs were gradually increases with increasing in duration of pre-op stay in both Pre-pandemic and Pandemic period. But it was more in Pandemic period than the other.

The incidence of SSIs were gradually increases with increasing in duration of surgery in both Pre-pandemic and Pandemic period. But it was more in Pandemic period than the other.

Table 3: Bacteriological profile

Sl.no.	Bacteria On Culture	Pre-pandemic period No. of Cases (%)	Pandemic period No. of cases (%)
1.	Staph. Aureus	35 (35%)	35 (35%)
2.	E. Coli	24 (24%)	40 (40%)
3.	Klebsiella	10 (10%)	15 (15%)
4.	Staph. Epidermidis	8 (08%)	3 (03%)
5.	Pseudomonas	6 (06%)	2 (02%)
6.	Enterococcus	5 (05%)	2 (02%)
7.	Acinetobacter	3 (03%)	1 (01%)
8.	Citobacter	1 (01%)	1 (01%)
9.	No growth	8 (08%)	1 (01%)
Total		100	100

Table 3: Shows – In Pre-pandemic and Pandemic period, most frequent organisms appeared in culture was Staph. aureus (35%) and E. Coli (40%) respectively. Then followed by E. Coli (24%), Klebsiella (10%) in Pre-pandemic period, and in Pandemic period by Staph. Aureus (35%), Klebsiella (15%). Out of 35 cases 15 (42.86%) in Pre-pandemic period, and out of 40 cases 20 (50%) in Pandemic period were found to be methicillin resistant. For Pseudomonas, 2 out of 6 cases (33.33%) in Pre-pandemic period, and 1 out of 2 cases (50%) in Pandemic period were resistant to Gentamicin.

Discussion

Among the many risk factors (both intrinsic and extrinsic) responsible for wound sepsis, few of them were discussed in this study.

1. Incidence of SSIs - Overall incidence rate in Pre-pandemic and Pandemic period were 26% and 36% respectively. Dose of bacterial contamination is important in the development of SSIs. As per Hall et al study, infection rates were more in contaminated and dirty procedures, and in emergency surgical procedures {9].
2. Incidence of SSIs with Age -The incidence in both groups (Pre-pandemic and Pandemic) were seen gradually increasing with age. In other words, older patients were more commonly associated with infected wounds due to reduced host defenses / immunity, atrophy of organs/systems. Elman and Srivastava observed the same [10,11]. On comparison, irrespective of age groups Pandemic period was more infectious.
3. Incidence of SSIs with BMI - Both extremes of BMI (i.e. < 20 Kg/m^2 and > 30 Kg/m^2) were associated with higher incidence of wound infections in both groups which may be due to poor tolerance of fatty tissue to bacterial contamination [12], i.e. both blood volume and blood flow per unit weight are lower in adipose tissues . On comparison, Pandemic period was more infectious than other in respective BMI.
4. Incidence of SSIs with Hb% - In both groups, on increasing in Hemoglobin level was inversely proportional to the incidence of SSIs, which may be due to inadequate tissue perfusion and hypoxia. On comparison of two groups, Pandemic period was more infectious than other in respective Hb% level.
5. Incidence of SSIs with Blood sugar level - The incidence in both groups (Pre-pandemic and Pandemic) were seen increasing with rise in blood sugar level. In other words, Diabetics are more prone to infection than non-diabetics. On comparison, irrespective of blood sugar level Pandemic period was more infectious. As per study by Uckay I et al, SSIs are higher in uncontrolled diabetes with ketoacidosis [13][10]
6. Incidence of SSIs with type and duration of surgery – Emergency and prolonged surgery relate to higher SSIs incidence in both groups. In long procedures, the opportunity to systemic insult to the patient, through blood loss is generally greater than in shorter procedures. On comparison, Pandemic period was more infectious than the other.
7. Incidence of SSIs with pre-op stay and pre-op antibiotics – Shorter pre-op stay and use of antibiotics prior to surgery relate to lower SSIs incidence rate [14] in both groups, which may be due to preventing replacement of normal bacterial flora of the patients to resistant hospital flora i.e. preventing primary colonization of patient with hospital acquired resistant microorganisms [11]. But some studies also conclude that increased incidence of SSIs with use of pre-op antibiotics [15]. On comparison, Pandemic period was more infectious than the other.
8. SARS-CoV-2 (7^{th} identified corona virus) contains a single stranded RNA genome covered with a protein membrane and protein spikes (S) on it's

surface, i.e. this protein has a unique way of binding with cell membrane protein, angiotensin converting enzyme 2 (ACE-2), on the surface of host cell. S surface protein plays key role in the viral life cycle and host defense response. It dysregulates of the host immune system (Innate, Adaptive and Humoral immunity) reflected by the cytokine norms.[16]

9. Higher grades like appendicular perforation and appendicular abscess, were more common in pandemic period comparison to pre-pandemic period where lower grades (like probable appendicitis, appendicitis) were predominant (p-value < 0.005), as per study by H.Javanmard-Emamghissi et al and Javier Romario et al .
10. This pandemic period affects diagnosis, treatment protocol, and increases post-operative complications, which may be due to delayed presentation in casualty department resulting delayed diagnosis and advanced stage of the disease. As a result of delayed presentation and no use of laparoscopic surgeries due to restriction imposed by the corona infection, post-operative hospital stay, and wound infection rate were also high [17].
11. Many factors were responsible for delayed presentation on hospital during pandemic period. In study by OriSnapiri et al concluded the fear of contracting with COVOD-19 in public places such as hospital or casualty, inadequate clinical examination in hospital set up and with more of telemedicine concepts resulting in misdiagnosis are quoted as primary reasons [18].
12. Another study by Lazzerini M et al in Italy postulated it reflects the scarcity of the resources available as a result of pandemic based resolutions and fear grip of the people to get exposed to corona infections in the hospital. [19] [11]

Conclusion

The higher incidence of SSIs in in this study was multifactorial, i.e. common risk factors for post-operative wound infections in both Pre-pandemic and Pandemic period were older patients, extremes of BMI (i.e. < 20 Kg/m^2 and > 30 Kg/m^2), diabetes, anemia, foci of infection, emergency surgeries, no use of pre-op antibiotics, prolonged pre-op stay and prolonged duration of surgeries. Staphylococcus aureus and E. coli remain the major culprit in SSIs in Pre-pandemic and Pandemic period respectively. Overall SSIs incidence rate in Pandemic period was higher than Pre-pandemic period, which may be due to dysregulation of all immune system (Innate, Adaptive and Humoral immunity), delayed presentation in casualty department resulting delayed diagnosis and advanced stage of the disease. As a result of delayed presentation and no use of laparoscopic surgeries due to restriction imposed by the corona infection, post-operative hospital stay and wound infection rate were also high.So identification of common pathogens and use of specific antibiotics after institutional SSI surveillance is required for controlling post-op wound infections.

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