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A CLINICAL STUDY ON FACTORS RESPONSIBLE FOR SURGICAL SITE INFECTIONS FOLLOWING EMERGENCY NONTRAUMATIC ABDOMINAL OPERATIONS

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ABSTRACT This study aims at finding out the common organisms responsible for surgical site infections following emergency non - traumatic abdominal operations and their sensitivity patterns of the microorganisms were ascertained. Determination of factors responsible for infections to reduce the infection rate and thereby reduce the morbidity and mortality. The patients admitted to various surgical wards in KIMS General Hospital, who are operated for emergency non -traumatic abdominal operations are included in this study. A proforma for study of all consecutive patients of emergency non-traumatic abdominal operations will be used. Culture and sensitivity of the organism at the surgical site infection are documented. Various statistical and epidemiological parameters used will be are mean and standard deviation. It was revealed that, overall surgical site infection rate was17.14 per cent. It was observed that among the various host factors studied age, sex, and educational status of the patients were not statistically significant, but presence of comorbidity played a significant role in causing SSI. Among the perioperative / environmental factors category of operations, types of incisions, and delay to initiate operation did not play significant role, but duration of operation and degree of wound contamination played statistically significant role. It can be concluded from the findings of the study that microorganisms that are normal inhabitants of our body are mainly responsible for surgical site infection (SSI). Various host factors like malnutrition, obesity, patients' knowledge about hygiene, presence of co- morbidity etc. coupled with environmental factors such as condition of the wounds, delay to initiate operation, duration of operation, prolonged exposure of peritoneal cavity to environment, prophylactic use of antibiotics and factors associated with surgery like type of incision, type of operation greatly contribute to occurrences of SSI. So, quality of surgical care including immediate assessment of patients, resuscitative measures, adequate preparation of patients and aseptic environment are important for control of SSI.

KEYWORDS : site infections (SSI), emergency abdominal operations, pathogenic organisms

INTRODUCTION

The infection of a wound can be defined as the invasion of organisms through tissues following a breakdown of local and systemic host defenses, leading to cellulitis, lymphangitis, abscess and bacteremia. Surgical site infection (SSI) has always been a major complication of surgery and trauma and has been documented for 4000-5000 years. Surgical Site Infections (SSIs), previously called post operative wound infections, result from bacterial contamination during or after a surgical procedure[1]. Surgical site infections are the third most common hospital associated infection, accounting for 14-16 per cent of all infections in hospitalized patients. Among surgical patients, surgical site infections are the most frequent cause of such infections, accounting for 38 per cent of the total[2]. Despite every effort to maintain asepsis,]most surgical wounds are contaminated to some extent. The criteria used to define surgical site infections have been standardized and described three different anatomic levels of infection: superficial incisional surgical site infection, deep incisional surgical site infection and organ/space surgical site infection (Doherty and Way 2006). According to the degree of contamination wounds may be classified as clean, potentially contaminated, contaminated, and dirty.

The incidence of infection, morbidity and mortality increases from clean to dirty. The risk of infection is greater in all categories if surgery is performed as an emergency (Kirk and Ribbans 2004). Important host factors include diabetes mellitus, hypoxemia, hypothermia, leucopenia, nicotine, long term use of steroids or immunosuppressive agents, malnutrition, nares contaminated with Staphylococcus Aureus and poor skin hygiene[3]. Perioperative / environmental factors are operative site shaving, breaks in operative sterile technique, early or delayed initiation of antimicrobial prophylaxis, inadequate intraoperative dosing of antimicrobial prophylaxis, infected or colonized surgical personnel, prolonged hypotension, poor operative room air quality, contaminated operating room instruments or environment and poor wound care postoperatively (Doherty and Way 2006)[4]. Wound infections usually appear between fifth and tenth post operative day, but they may appear as early as first post operative day or even years later[5]. The first sign is usually fever, and post operative fever requires inspection of the wound[6]. Advances in the control of infection in surgery have occurred in many ways, such as, antibiotics have reduced post operative infection rates, delayed primary or secondary closure remains useful in contaminated wounds. According to the sources, infection may be classified into two types, primary and secondary or exogenous. The use of antibiotic prophylaxis before surgery has evolved greatly in the last twenty years. It is generally recommended in elective clean surgical procedures using a foreign body and in clean-contaminated procedures that a single dose of cephalosporin, such as cefazolin, be administered intravenously by anesthesia personnel in the operative suit just before incision[8]. Additional doses are generally recommended only when the operation lasts for longer than two to three hours[9](Nichols 2009). Surgical site infection is the most important cause of morbidity and mortality in the post operative patients, but it is preventable in most of the cases if proper assessment and appropriate measures are taken by the surgeons, nursing staffs, patients and others in the perioperative period[10]. So this study is taken up to determine the factors responsible for surgical site infections following emergency non-traumatic abdominal operations, which will be helpful in reducing the rate of surgical site infection To determine the host factors responsible for surgical site infections, to detect the environmental factors contributing to surgical site infections following emergency non traumatic abdominal operations and to identify the microorganisms involved in surgical site infections.

MATERIALS AND METHODS:

Descriptive type of cross-sectional study. Prior to commencement of this study Thesis and Ethical Committee of KIMS had approved the thesis protocol. Fifty patients having emergency nontraumatic abdominal operations in Surgery unit, KIMS General Hospital during July,2021 to September, 2021 are included in the study. Method of sampling was non-random, purposive. After admission short history was taken and physical examination was conducted on each patient admitted in surgery unit who fulfilled the inclusion criteria. Only very essential investigations were done urgently for taking correct decision about the management. Patients requiring emergency abdominal surgery and fulfilling the inclusion criteria were offered to participate in the study. All the traumatic cases were excluded from the study. Informed written consent was taken from the patients or their guardian willing to participate in the study. Detailed history was taken from the study group to establish proper diagnosis and to know about the presence of the risk factors regarding surgical site infection. All of the preoperative factors related to SSI present in the patient were noted down in the data sheet. After proper resuscitation (where applicable) and preparation, patients were sent to operation theatre for operation.

Strict aseptic precautions were followed during the operation. The operation procedure and related preoperative factors were observed directly and recorded in the data collection sheet instantly. During the postoperative period all the patients were closely monitored everyday up to the discharge of the patient from the hospital. If any symptom or sign of infection appear during this period then proper investigation was instituted for the diagnosis of infection and to assess the type and severity of the infection. If any collection of pus identified it was drained out and sent for culture and sensitivity test. Proper antibiotic was given to every patient both preoperative and post-operative periods. Appropriate management was given to each of the patients of surgical site infection. Antibiotic was changed where necessary after getting the report of culture and sensitivity test. Postoperative events were recorded in the data sheet during every day follow up. After completing the data collection, it was compiled in a systematic way.

Table – 1 Age Distribution Of The Patients

Age in years	Percentage (%)
10 - 19	22.14
20 - 29	21.42
30 – 39	21.42
40 - 49	24.28
50 – 59	6.43
60 – 69	4.29
Total	100

Mean ± SD = (32.93± 3.79) years.

It was observed that age of 50 patients ranged from 13 -6 5 years. Most of the patients (89.29 %) were in between 10 -49 years.

Table – 2 Surgical Site Infection (ssi) Distribution By Different Age Groups In Percentage

Age in years	SSI status	
	yes	No
10 - 19	16.13	83.87
20 - 29	6.67	93.33
30 – 39	16.67	83.33
40 - 49	26.47	73.53
50 – 59	22.23	77.77
60 – 69	16.67	83.33
Total	17.14	82.86

It was observed that rate of SSI in different age groups were as follows: 5 (16.13 %) in the 10 -19 years, 2 (6.67 %) in the 20 - 29 years, 5 (16.67 %) in the 30 - 39 years, 9 (26.47 %) in the 40 - 49 years, 2 (22.23 %) in the 50 - 59 years and 1 (16.67 %) in the 60 - 69 years. It was highest 26. 47 % (9 among 34) in the 40 - 49 years.

Table 3: Number of operations, SSIs and SSI rate (%) by category

Type of operation	SSI status	
	yes	No
Appendicectomy	8.33	91.67
Resection and anastomosis	10	90
Repair of ileal perforation	42.10	57.89
Repair of duodenal ulcer perforation	20	80
Appendicectomy with peritoneal toileting	33.33	66.66
Resection of volvulus of sigmoid colon and primary anastomosis/ Hartmann's procedure	50	50
Herniotomy/Herniorrhaphy	0	100
Total	17.14	82.86

Out of 50 patients with emergency nontraumatic abdominal operations, rate of SSI in different operations were observed. It was found that out of acute appendicitis cases 8.33 % developed SSI, out of small intestinal obstruction cases 10.00% developed SSI, out of ileal perforation cases 42.10 % developed SSI, out of duodenal ulcer perforation 20.00 % developed SSI, out of burst appendix cases 33.33 % developed SSI, out of sigmoid volvulus cases 50.00% developed SSI and it was nil between obstructed inguinal hernia.

Table 4: SSI distribution based on different types of incision.

Type of incision	SSI status	
	yes	No
Expended lower midline	50	50
Mid Mid line	42.11	57.89
Lower right para median	33.33	66.66
Rutherford Morison	20	80
Upper midline	13.33	86.66
Gridiron	5	95
Lanz	0	100
Inguinal	0	100
Total	17.14	82.86

Rate of SSI was highest, 50.00 % operations done through extended lower midline incision, whereas rate of SSI was 42.11 % in mid midline, 33.33 % in lower right para -median, 20.00 % in Rutherford Morison, 13.33 % in upper midline, 13.33 % in extended upper midline and 5.00 % in gridiron incisions. No infection occurred in operations done through Lenz incision and operations through inguinal incisions.

Table- 5: SSI distribution based on delay to initiate operation in percentage.

Delay in time of incision	SSI status	
	yes	No
<6 hours	9.09	90.91
6-12 hours	10.53	89.47
12-24 hours	15.63	84.37
24-48 hours	18.42	81.58
48-72 hours	19.35	80.65
>72 hours	33.33	66.66
Total	17.14	82.86

With regard to association between delay to initiate operation and rate of SSI it was observed that the surgical site infection rates were 9.09%, 10.53%, 15.63%, 18.42%, 19.35% and 33.33% when operations were initiated <6, 6 -12, 12-24, 24-48, 48-72 and >72 hours later respectively.

The rate of infection increased as the time lapse between appearance of first symptom and initiation of operation were increased.

Table 6: SSI distribution based on duration of operations in percentage.

Duration of Operation	SSI status	
	yes	No
<1 hour	4.60	95.40
1-2 hours	32.55	67.45
>2 hours	60	40
Total	17.14	82.86

The rate of SSI increased with prolongation of duration of operation. The difference in percentage of SSI with duration of operation was statistically significant ($P < 0.001$).

Table 7: SSI distribution based on types of wounds by the degree of contamination in percentage.

Duration of Operation	SSI status	
	yes	No
Clean	4.35	95.65
Clean Contaminated	8.33	91.67
Contaminated	27.27	72.73
Dirty	32.61	67.39
Total	17.14	82.86

The rate of SSI was as high as 32.61 %) dirty cases. The difference had high statistical significance ($P < 0.01$). It can be assumed that the infection rate increased with that of degree of wound contamination.

Table 7: Surgical site infection distribution based on presence of different co-morbidities in percentage.

Type of co-morbidity	SSI status	
	yes	No
Malnutrition	45.12	54.17
COPD	28.57	71.43
Diabetes Meletus	33.33	66.67
Obesity	33.33	66.67
Medical Jaundice	50	50
Total	40.48	59.52

In patients with malnutrition 45.12 % developed SSI, whereas among patients with COPD 28.57 % developed SSI and diabetic, among them 33.33 % suffered from SSI. obese, of them 33.33 % developed SSI.

Table 8: Sensitivity pattern of the cultured micro -organisms to various antibiotics.

Name of microorganisms	Antibiotics and their sensitivity in percentage						
Escherichia coli	45.45	54.54	45.45	-	9.09	72.72	100
Staphylococcus Aureus	44.45	44.45	-	55.55	-	88.9	100
Klebsiella pneumoniae	-	50	50	-	-	100	100
Pseudomonas aeruginosa	50	-	-	-	50	100	100

Escherichia coli were sensitive to Ciprofloxacin (45.45% cases), Cephradine (54.54% cases), Cotrimoxazole (45.45 % cases), Nitrofurantoin (9.09 % cases), Ceftriaxone (72.72% cases) and Imipenem (100% cases). All the cases of E. coli were resistant to flucloxacillin.

Staphylococcus aureus were sensitive to Ciprofloxacin (44.45% cases), Cephradine (44.45% cases), Flucloxacin (55.55% cases), Ceftriaxone (88.9% cases) and Imipenem (100% cases). But, all the cases of Staph Aureus were resistant to Cotrimoxazole and Nitrofurantoin.

Klebsiella pneumoniae were sensitive to Cephradine and Cotrimoxazole in 50 per cent cases each and to Ceftriaxone and Imipenem in all (100 per cent) cases. But, all the cases of Kl. Pneumoniae were resistant to Ciprofloxacin, Flucloxacillin and Nitrofurantoin.

Fifty (50) percent cases of Pseudomonas aeruginosa were sensitive to Ciprofloxacin and Nitrofurantoin, and all the cases of P. aeruginosa (100%) sensitive to Ceftriaxone and Imipenem. All of them (100%) were sensitive to Imipenem and were resistant to Cephradine, Cotrimoxazole and Flucloxacillin.

DISCUSSION:

This descriptive, cross -sectional study was conducted among 50 purposively selected patients with emergency non -traumatic abdominal operations conducted in surgery unit of KIMS General Hospital. The study was carried out with a view to determine the factors responsible for surgical site infections (SSI) following emergency non-traumatic abdominal operation which will be helpful in reducing the rate of surgical site infection in the near future. Age of 50 patients ranged from 13 - 65 years. Most of the patients (125, 89.29 %) were in between 10 -49 years; with mean age 32.93 years and standard deviation 3.79 years (Table 1). In a similar study conducted in an Iranian teaching hospital average age of the patients was 46.70 years (Razavi et al. 2005). Average age of the patients in the Iranian study was much higher than the present study.It was revealed that among 50 patients 24 (17.14%) developed surgical site infection (SSI). Overall rate of SSI was 17.14 %. This finding is consistent with the finding of Razavi et al. where they found 139 patients among 802 (17.40 %) suffered from SSI (Razavi et al. 2005). The overall SSI rate of present consistent with findings of study carried out by Renvall et al., in which SSI rate in acute surgery was 12.4 per cent (Renvall et al.1980) It was observed that rate of SSI in different age groups was 16.13 % in the 10-19 years, 6.67 % in the 20 -29 years, 16.67 % in the 30-39 years, 26.47 % in the 40 -49 years, 22.23 % in the 50 -59 years and 20.00 % in the 60-69 years. It was highest 26.47 % (9 among 34) in the 40-49 years age group (Table 2). This finding is inconsistent with the findings of an Iranian study where they showed the rate of SSI 3.70 % in < 25 years age group, 18.10 % in 25-65 years age group and 25.20 % in > 65 years age group (P <0.001) (Razavi *et al.* 2005). Inconsistency may be due to small number of old aged population in my study. It was observed that host factors like type of disease, presence/absence of comorbidity and types of co - morbidity and other factors like delay to initiate operation and duration of surgery were associated with the rate of surgical site infection Out of 50 patients with emergency nontraumatic abdominal operations, rate of SSI in different operations were as follows:8.33% acute appendicitis cases, 10.00% small intestinal obstruction, 42.10% ileal perforation, 20.00% duodenal ulcer perforation, 33.33% burst appendix, 50.00% sigmoid volvulus and no SSI occurred in obstructed inguinal hernia cases. The highest rate of infection (50.00%) was in volvulus cases and lowest in obstructed hernia operations (Table 3). These findings were consistent with the result of Surgical Site Infection Surveillance (SSIS) for general surgery which was published as Wexford General Hospital Surgical Site Infection (SSI) data report in 2009 showing number of SSI and rate of SSI (%) by category of operations[11].They done 132 appendicectomy, among them SSI occurred in 7 (5.3%) cases. SSI occurred in 10 (19.2 %) cases among 52 Colonic surgeries, 4 (23.5%) cases among 17 Small bowel surgery and 5(26.3%) cases among 19 Laparotomies. No SSI was reported among 82 herniorrhaphy cases (Surgical Site Infection Surveillance for general surgery 2009) Regarding incision-wise infection rate, rate of SSI was highest, 50.00%) operations done through extended lower midline incision, whereas rate of SSI was 42.11%) in mid midline, 33.33%) in lower right para-median,20.00%) in RutherfordMorison,13.33%) in upper midline, 13.33%) in extended upper midline and5.00%) in grid iron incisions. No infection occurred in operations done through Lenz incision and operations through inguinal incisions (Table 4). In present study infection rate was higher in midline incisions that may be attributed to less vascularity of the Linea alba and most contaminated and dirty cases were operated through these incisions. The findings were consistent with the findings of study carried out by Paul in 2004, where the infection rate was 50.00 per cent for Rutherford Morison, 25 per cent for each of right para median and extended midline, 18.18 per cent for upper midline, 9.38 per cent for grid iron incision and nil for inguinal incision[12]With regard to delay to initiate operation and rate of SSI, it was observed that the surgical site infection rate was 9.09%,10.53%, 15.63%, 18.42%, 19.35% and 33.33% when operation was initiated <6, 6-12, 12-24, 24-48, 48-72 and >72 hours later respectively. The rate of SSI increased as the time lapse between first manifestation of symptoms and initiation of operation prolonged (Table 5). This is similar to the findings of Huda M.N. who conducted a study in Dhaka Medical College in 2005. In that study SSI rate was 15.25%, 21.73%, 27.27%, 40% and 50% respectively when operations were done 6, 12, 24, 48, and 72 hours later (Huda 2005). This findings is also consistent with the findings of a study conducted in a Peruvian hospital; i n which patients with SSI had a longer hospital stay than did non -infected patients (14.0Vs 6.1 days; p < 0.001); it is because prolonged preoperative hospital stay increases SSI rate and occurrence of SSI causes prolonged postoperative stay (Hernandez *et al* 2005).With respect to duration of operation and percentage of SSI it was observed that the infection rate varies with duration of operation. It was only 4.6 % when the duration of operation was less than one hour. The rate rises with the prolongation of operation. Infection rate was 32.55% when the duration of operation was between one and two hours. The infection rate was as high as 60.00 per cent when duration of operation was more than two hours. The rate of SSI increased statistically very significantly with that of duration of operation (P < 0.001). It may be due to the prolonged exposure of the wound to the environment leading to more chance to inoculation of micro - organisms. These findings are consistent with the findings of a study conducted in the Imam Khomeni Hospital, Tehran, where the authors comment, the duration of surgical operation also proved to be a significant factor: only 3 % of operations lasting 30 minutes or less led to infection, while for operations lasting more than 6 hours this rate leapt to 18%. (Razavi etal.2005)[13]. In relation to appearance of infection by features like fever, excessive pain, tenderness or discharge from the wound on postoperative days it was observed that most of the infections were started between 4th and 8th post operative days (PODs) and it was highest (33.33%) on 5th POD. Among the total of twenty four patients with surgical site infection, in only one patient (4.17%) features of infection first appeared on 3rd POD and it was three (12.50%), eight (33.33%), six (25%), three (12.50%), two (8.33%) and one (4.17%) persons who presents with features of infection on 4th, 5th, 6th, 7th, 8th and 9th POD respectively. No infection started on 1st, 2nd and 10th POD, Among the patients with co -morbid disorders, 40ty.48 %) developed surgical site infection (SSI), whereas, in the patients without any co-morbidity 7.14 %) developed SSI (). The difference of rate of infection between these two groups was very obvious. It was clear that associated co -morbid disorders played a vital role as a host related risk factor for SSI. Moreover, the difference was statistically significant (P < 0.001). It was observed that infection rate was 45.12 per cent in clinically malnourished patients, whereas it was 28.57 per cent in COPD cases and 33.33 per cent in obese patients. Moreover, two patients underwent laparotomy with medical jaundice. Of them one (50 %) developed SSI. In addition of six patients with diabetes mellitus underwent emergency abdominal surgery. Of them two patients (33.33%) developed SSI (). Israelsson and Jonsson identified increased rate of SSI among overweight patients (Israelsson and Jonsson 1997). Another study by Cruse and Frood showed that clean wound infection rate rises to 10.7% in patients with diabeties, 13.5% in obesity and 16.6% in malnourished patients

(Cruse and Frood 1980) For the prevention of surgical site infection antibiotics such as Ceftriaxone, Cefuroxime, Ciprofloxacin, Metronidazole were used in pre-operative and postoperative period in all of the cases. This has contrasting evidence as showed by Rasul and Ashraf in their study conducted in 1979 who did not use antibiotics in any of 65 selected cases and there was not a single incidence of wound infection (Rasul and Ashraf 1979).Regarding sensitivity of the micro - organisms it was observed that, Escherichia coli were sensitive to Ciprofloxacin (45.45% cases), Cephradine (54.54% cases), Cotrimoxazole (45.45 % cases), Nitrofurantoin (9.09 % cases), Ceftriaxone (72.72% cases) and Imipenem (100% cases). All the cases of E. coli were resistant to flucloxacillin (Table 8). These findings are consistent with that of Iqbal et al. They studied sensitivity pattern on 378 isolates of E. coli from different sources and found susceptible to imipenem (99.7%), Tazobactam (99%), Amikacin (99%), Nitrofurantoin (92%), Ceftriaxone (66%) and ciprofloxacin (55%). Majority of the isolates were resistant to Cotrimoxazole (72%) and Ampicillin (76%) (Iqbal et al 2002). Staphylococcus aureus were sensitive to Ciprofloxacin (44.45% cases), Cephradine (44.45% cases), Flucloxacin (55.55% cases), Ceftriaxone (88.90 % cases) and Imipenem (100.00% cases). But, in all the cases Staph. Aureus were resistant to Cotrimoxazole and Nitrofurantoin. This finding can be compared with the findings of a national survey in Ireland done in 1993. The overall percentage of S. aureus sensitivity to the tested antibiotic were as follows: Methicillin 85%, penicillin 8%, gentamycin 89%, ciprofloxacin 85%, erythromycin 80%, fusidic acid 96 % and mupirocin 98% (Moorhouse et al. 1996). Here, sensitivity of the organisms to ciprofloxacin is much higher than the present study. Results are inconstant with that of present study; it may be due to limited number of isolates in the present study and variation in the methodology. Klebsiella pneumoniae were sensitive to Cephradine and Cotrimoxazole in 50 per cent cases each. All of the cases (100.00%) were sensitive to Ceftriaxone and Imipenem. But, all the cases of Kl. Pneumoniae were resistant to Ciprofloxacin, Flucloxacillin and Nitrofurantoin. These findings are similar to that of Sultan et al. They stated in their study result that, the micro flora of intra abdominal infections were usually found sensitive to 3rd generation cephalosporins, tazobactam Imipenem, quinolones, clindamycin and amikacin (Sultan et al. 2007). Fifty percent cases of Pseudomonas aeruginosa were sensitive to Ciprofloxacin and Nitrofurantoin. All the cases of P. aeruginosa (100.00%) sensitive to Ceftriaxone and Imipenem m. All of them (100.00%) were resistant to Cephradine, Cotrimoxazole and Flucloxacillin. This finding is comparable with that of Ozumba Nigeria, who studied antibiotic sensitivity pattern on 229 clinical isolates of Pseudomonas aeruginosa[14]. Majority of isolates tested were susceptible to Ceftazidime (88.5%), Colistin (83.75%), Ciprofloxacin (62.1%) and Ofloxacin (62.5%). These were less susceptible to Ceftriaxone (45.1%), Gentamycin (44.1%), Cotrimoxazole (0.7%) and Nitrofurantoin (6.7%) (Ozumba 2003). All the organisms isolated (100.00%) were sensitive to Imipenem because this is an excellent newer drug with broad spectrum of activity and another fact is that it is not a commonly used drug. so, development of resistance is uncommon. Use of newer drugs should be reserved for specific cases and must not be used empirically or prophylactically.

CONCLUSIONS

On the basis of the findings of the study, the following recommend ations can be made

1) Prompt diagnosis, proper assessment, quick resuscitation and appropriate preoperative preparation are keys to better outcome in emergency operations, but undue delay should be avoided in treating any emergency condition
2) Duration of operation should be optimum to minimize the level of wound contamination and prevention of SSI.
3) Proper care of the patients as a whole throughout the peri - operative period is very vital to reduce the rate of surgical site infection.
4) Appropriate antibiotic prophylaxis should be practiced.
5) Further research is necessary in large scale for guidance regarding prevention of surgical site infections in our country

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