

ORIGINAL RESEARCH

Spectrum of aerobic and anaerobic bacteria in surgical site infection among orthopaedic patients having implant

¹Dr. Pranjal Nema, ²Dr. Anushi Hardaha, ³Dr. Neelu Jain, ⁴Dr. Shubhra Dubey, ⁵Dr. Amardeep Rai

^{1,2,4}PG Resident, ³Associate Professor, ⁵Professor and HOD, Department of Microbiology, Government Bundelkhand Medical College, Sagar, M.P., India

Corresponding Author

Dr. Pranjal Nema

PG Resident, Department of Microbiology, Government Bundelkhand Medical College, Sagar, M.P., India

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ABSTRACT

Background: Surgical site infection in orthopedic implants is a major problem, causing long hospital stay, cost to the patient and is a burden on health care facilities. It increases rate of nonunion, osteomyelitis, implant failure, sepsis, multiorgan dysfunction and even death. Surgical site infection in orthopedic implants is more challenging to the treating orthopedic surgeon as the causative organism is protected by a biofilm over the implant's surface. Antibiotics cannot cross this film to reach the bacteria's, causing infection. Many bacteria have developed resistant to various drugs, and its frequency is increasing day by day. **Methodology Study design:** Prospective cross sectional study. **Study Centre:** Bundelkhand Medical College, Sagar, Madhya Pradesh. **Study duration:** July 2021 to June 2022. **Methods and material:** All the post operative patients of Open Reduction and Internal Fixation at tertiary care centre, BMC, Sagar undergoing surgery and developing surgical site infection as diagnosed clinically by physician will be enrolled to study. **SPECIMEN COLLECTION :-** After taking written consent for sample collection, pus samples from all open reduction and Internal Fixation patient will be collected by sterile swab stick or syringes / suitable media. **ISOLATION AND IDENTIFICATION** of aerobic and anaerobic bacteria will be done by gram staining and culture in suitable media as per standard microbiological procedures along with suitable biochemical tests and antibiotic sensitivity test as per CLSI guidelines. **Result:** Total of 166 patients admitted to the orthopedic ward were approached, 19 patients were excluded, 9 patients refused to participate, and the remaining 138 patients were enrolled in the present study. The bacteria isolated and identified after laboratory culture. The single most common bacteria in the present study were Staphylococcus Aureus (54.3%) distantly followed by E. coli (18.1%) and Pseudomonas aeruginosa (12.5%). Among the 5 other bacteria, there were 3 cases of Staph. Epidermidis and 2 cases of Staph saprophyticus. **Interpretation & conclusions:** The most common location for the fracture was the distal femur (29.7%), followed by the proximal tibia (25.3%) and fracture of forearm bones (2.17%), fracture of humerus and metacarpal was the least common type of fracture. The single most common bacteria in the present study were Staphylococcus Aureus (54.3%) distantly followed by E. coli (18.1%) and Pseudomonas aeruginosa (12.5%). Among the 5 other bacteria, there were 3 cases of Staph. Epidermidis and 2 cases of Staph saprophyticus. 138 patients with fractures were included in our study; 64% were males and 35% were females, 65% of them had open or compound fractures, and the remaining 35% had closed fractures. So, for open/compound fractures, bacterial culture and sensitivity testing is done more.

Keywords: Fracture, Bacteria, Antibiotic sensitivity.

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INTRODUCTION

Surgical site infections (SSI) are preventable events that can result in severe morbidity, mortality, and healthcare costs for patients and the healthcare system(1,2). Those with SSIs are up to sixty percent more likely to remain in the intensive care unit, five times more likely to be readmitted to the hospital, and twice as likely to die compared to patients without SSIs(3,4). Once acquiring SSI, patients may endure an extended hospital stay, higher discomfort, and an increased burden of medical treatment, as well as a

number of unfavourable outcomes, such as problems with bone union, joint dysfunction, and limb amputation(5,6). Several studies indicated that the cost of therapy for a surgical site infection is 115% more than for a patient without SSI, and that surgical infections can extend the hospital stay of orthopaedic patients from 12 to more than 20 days(7-9).

Surgical site infection (SSI) is one of the most prevalent causes of hospital-acquired infection (HAI), accounting for 20 to 25 percent of all HAI worldwide(6). Even though orthopaedic surgery is

characterised as clean and strict aseptic procedures and antibiotic prophylaxis are routinely applied, surgical site infections (SSIs) continue to be an important consequence that must be managed(3,4,10). With an incidence of 5-10%, infection at the surgical site is one of the most prevalent postoperative complications(3,4,10). SSI can arise both early and late in the course of treatment. In early SSI, it can arise up to 30 days after surgery, whereas in late cases, it can appear 1 to 2 years following surgery and prosthesis installation(6,8,11,12). Orthopaedic procedures and trauma patients have a higher incidence of late-onset surgical site infection than other specialties, with up to 20% of all surgical site infections predicted to develop in orthopaedic patients(6,8,11,12). Increasing orthopaedic reasons, the complexity of orthopaedic surgery, and the use of implants in orthopaedic surgery all increase the risk of surgical site infection (SSI)(5,13,14).

Patients undergoing orthopaedic surgery are at risk for developing a number of complications that increase the risk for SSI, such as contamination of surgical site from the skin normal flora and airborne bacteria from surgical personnel and the operating theatre environment(15–17); therefore, it is important to address the risk factors for orthopaedic SSI in health care institutions performing orthopaedic surgery and throughout the preoperative, intraoperative, and postoperative periods(18,19). In the literature, a number of risk factors for orthopaedic SSI have been identified and classified as preoperative risk factors, such as male sex, obesity, and diabetes; intraoperative risk factors, such as operation room traffic, and the pattern of prophylactic antibiotic use; and postoperative risk factors, such as blood transfusion and drainage of the wound(20,21). Determining risk factors for orthopaedic SSI prior to surgery enables the implementation of precautionary measures that may prevent the incidence of orthopaedic SSI.

MATERIAL AND METHODS

Study Design: This was a single centre, hospital (in-patient) based, Prospective cross-sectional study done in Department of Microbiology, Bundelkhand Medical College, and affiliated hospitals, Sagar, Madhya Pradesh. It is a tertiary care institute. The total duration of the study was twelve months; from 27/07/2021 to 27/07/2022.

Collection of sample/specimen for assessment: Necrotic material or Pus Sample Collected under all aseptic precaution and Kept in a swab with sterile test tube, Syringe then sent to the Microbiology laboratory within 15 minutes

Assessment by laboratory culture:

- PRIMARY SMEAR EXAMINATION:** A smear is prepared and stained by Gram-staining method.
- ISOLATION AND IDENTIFICATION:** The isolates are identified by colonial morphology, Gram's stain, and conventional biochemical test.
- FOR AEROBIC BACTERIA IDENTIFICATION:** Specimen is streaked onto the surface of Blood agar and McConkey's agar. The plates incubated at 37°C overnight for 18-24 hours aerobically and growth is examined.
- FOR ANAEROBIC BACTERIA IDENTIFICATION:** Specimen is inoculated on suitable media like anaerobic blood agar, RCM broth etc. Culture plates kept in mcintosh and fildes jar for 24-48 hours with gas pak system for maintaining anaerobic environment and later examined for any growth.

IDENTIFICATION OF THE CAUSATIVE AGENT

SECONDARY SMEAR EXAMINATION

- The smear made from bacterial culture is air dried and then heat fixed and Gram staining was done.

BIOCHEMICAL TESTS

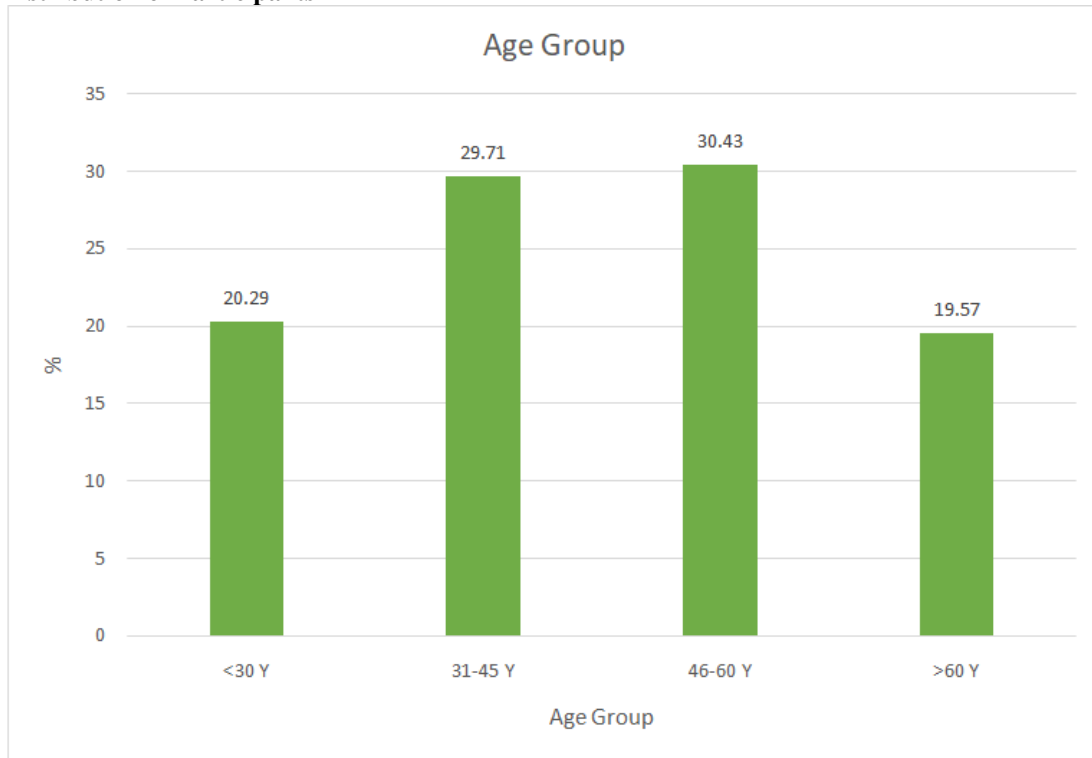
- Based on the type of organisms observed in secondary gram staining, appropriate biochemical tests are employed. Initially, catalase and oxidase tests are done on all the types of colonies grown on the media.

For gram-negative bacilli: Common biochemical tests routinely done are: Indole test, Citrate utilization test, Urea hydrolysis test, Triple sugar iron test (TSI), MR (methyl red) test, OF test (oxidation-fermentation test), Nitrate reduction test.

RESULTS AND OBSERVATIONS

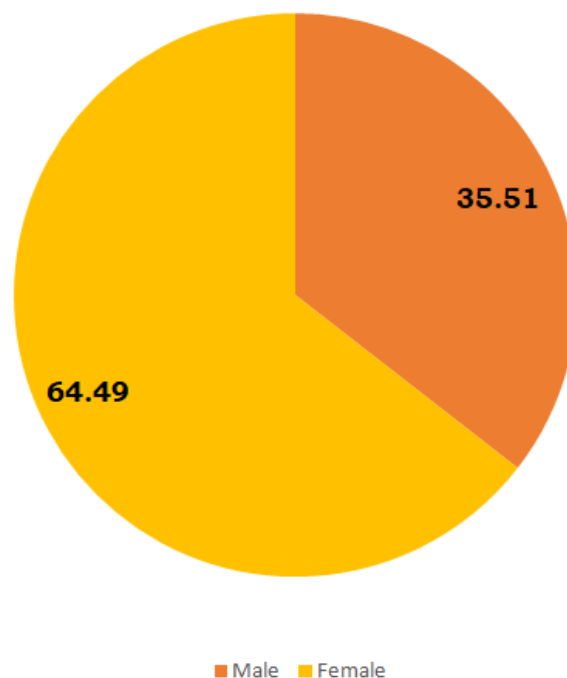
- Total of 166 patients admitted to the orthopedic ward were approached, 19 patients were excluded, 9 patients refused to participate, and the remaining 138 patients were enrolled in the present study.

Age Distribution of Participants



GENDER OF PARTICIPANTS (N= 138)

In the present study, about 65% of the participants were male and the remaining 35% of participants were female



LOCATION OF FRACTURE

The anatomical location of the fracture among the participants. In the present study, the most common location for the fracture was the distal femur (29.7%), followed by the proximal tibia (25.3%) and fracture of forearm bones (radius & ulna) (3 participants: 2.17%), humerus (2 participants: 1.44%) & fracture of metacarpal (1

participants; 0.72%) was the least common type of fracture.

Location of fracture

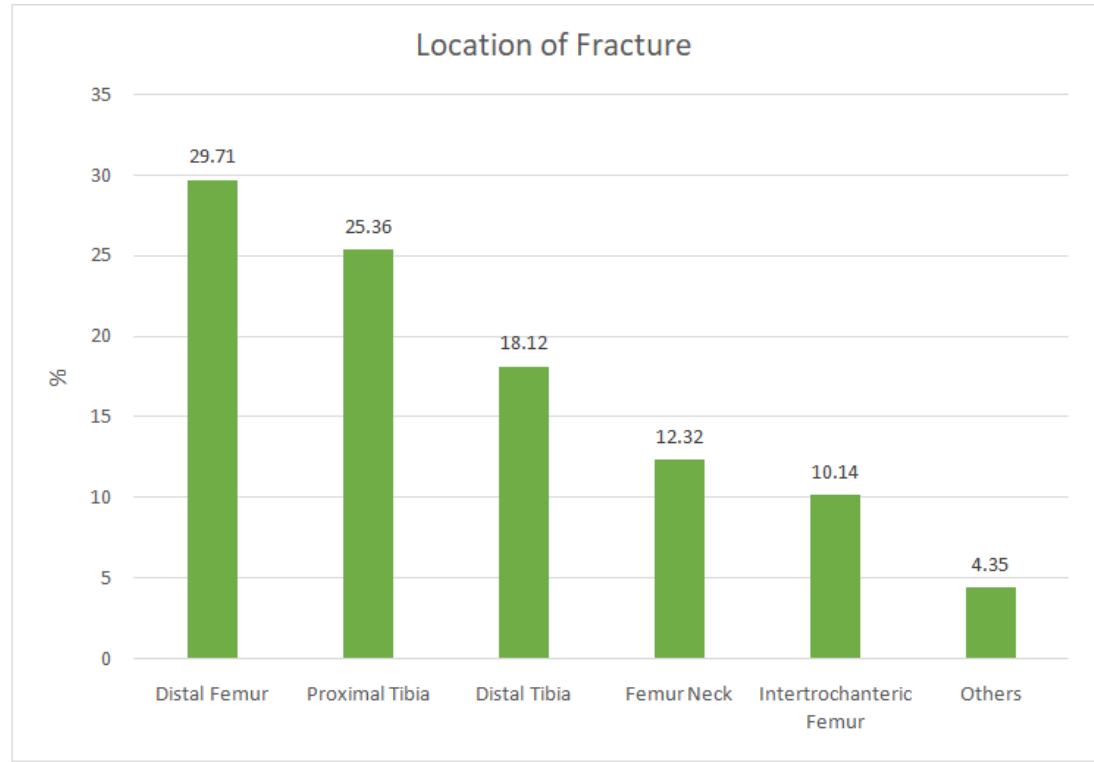
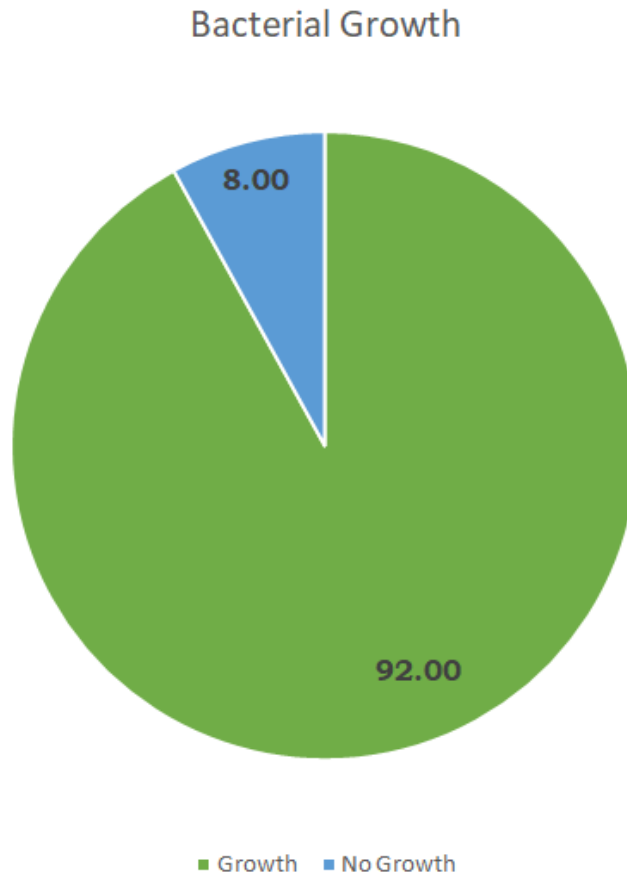


Figure 4.6: Bacterial Growth on Culture



ISOLATED BACTERIA

The bacteria isolated and identified after laboratory culture. The single most common bacteria in the present study were Staphylococcus Aureus (54.3%) distantly followed by E. coli (18.1%) and Pseudomonas aeruginosa (12.5%). Among the 5 other bacteria, there were 3 cases of Staph. Epidermidis and 2 cases of Staph saprophyticus.

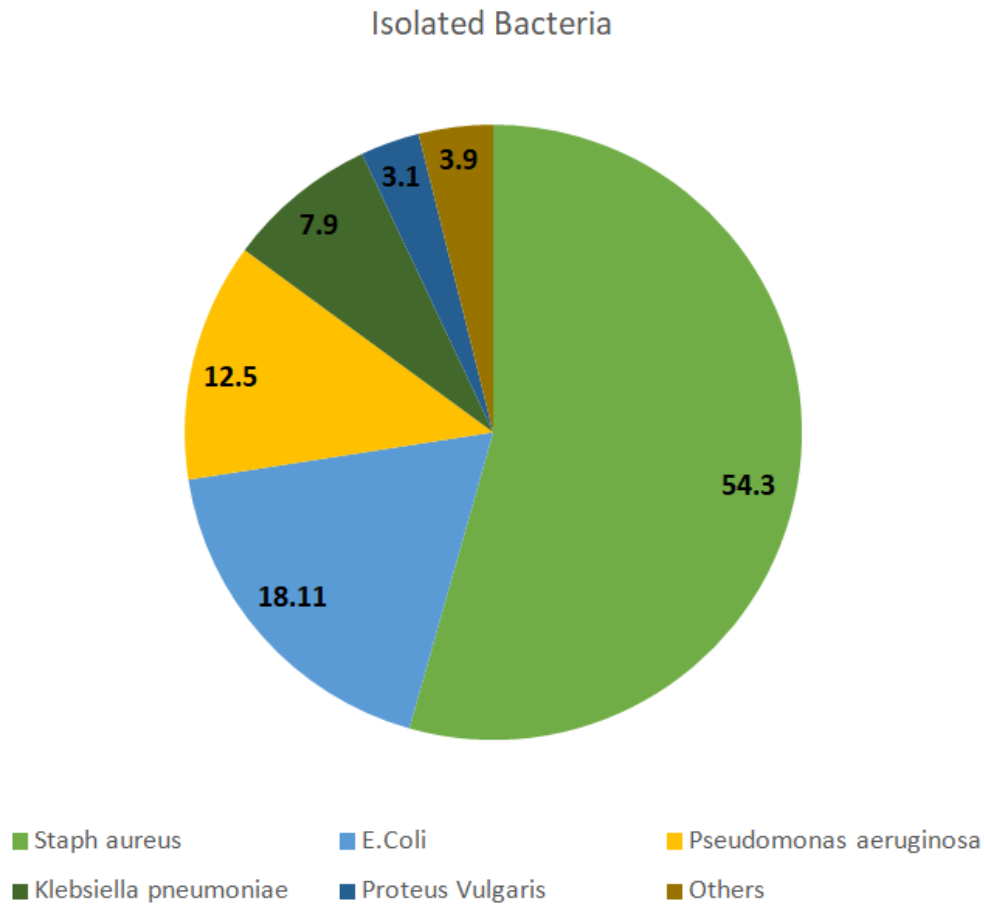


Table 4.14: Nature of bacteria isolated from the culture

Metabolism	Type of Fracture		
	Open	Closed	Total
Aerobic	84	43	127
	100.0	100.0	100.0
Anaerobic	0	0	0
	0.0	0.0	0.0
Total	84	43	127

There was no anaerobic growth on bacterial culture and all isolated bacteria were aerobic.

DISCUSSION

In the present study, the most common location for the fracture was the distal femur (29.7%), followed by the proximal tibia (25.3%) and fracture of forearm bones (2.17%), fracture of humerus and metacarpal was the least common type of fracture. The single most common bacteria in the present study were Staphylococcus Aureus (54.3%) distantly followed by E. coli (18.1%) and Pseudomonas aeruginosa (12.5%). Among the 5 other bacteria, there were 3 cases of Staph. Epidermidis and 2 cases of Staph saprophyticus.

In the present study, the single most common bacteria

in the present study were Staph. Aureus (54.3%) distantly followed by E. coli (18.1%) and Pseudomonas aeruginosa (12.5%). The results of the present study are in line with the vast literature published on the subjects. Several studies including the systematic review and hospital records containing the observations for several years have all reported that Staph aureus is the most common bacteria isolated in the case of both open and closed fractures. In addition, Staphylococcus aureus is also the most common bacteria isolated from non-orthopaedic surgical site infections. Several studies have concluded that nasal carriers of Staph aureus are at

increased risk of SSI. Similar to our findings, **Madu KA et al. (2011)** also reported that staphylococcus aureus was the most common causative organism in 55.6% of cases (75). **Mulhim FA et al (2014)** reported that the most common infective organism was Staphylococcus species including Methicillin-Resistant Staphylococcus aureus (MRSA) (29.11%); Acinetobacter species (21.5%); Pseudomonas, (18.9%); and Enterococcus species (17.7%). In their study three (3.78%) patients died as a result of uncontrolled septicemia (4). **Kalmeijer MD et al. (2015)** reported that the main causative pathogen was S aureus. The authors concluded that high-level nasal carriage of S aureus was the most important and only significant independent risk factor for developing SSI with S aureus (73). **Shah MQ et al. (2017)** reported that Staphylococcus Aureus was isolated from all 7 patients having SSI. Staphylococcus aureus was sensitive to Azithromycin, Penicillin, Doxycycline, Vancomycin, Chloramphenicol, Levofloxacin, Ciprofloxacin, Gentamycin were partially effective (25). **Masters J et al. (2017)**, explored the reported rate of surgical site infection (SSI) among 20 studies reporting data from 88,615 patients (42) (90). When analysed by operation type, the SSI incidences were highest among hip surgeries. **Norris GR et al., (2019)** reported that the most commonly cultured bacteria specimens were found in periarticular knee infections (10). They included data from a total of 11,432 patients. Overall, 653 patients (5.7%) experienced deep SSIs, most commonly among patients with proximal tibia fractures. **Motifard M et al (2021)**, investigated the prevalence of bacterial infections in traumatic operated patients (11). Data from 157 patients were analysed and showed that the most common site of infection was the knee in 46 patients (29.3%).

CONCLUSION

- 138 patients with fractures were included in our study; 64% were males and 35% were females, 65% of them had open or compound fractures, and the remaining 35% had closed fractures. So, for open/compound fractures, bacterial culture and sensitivity testing is done more.
 - The distal femur (29.7% of fractures) and proximal tibia (25.3% of fractures) are the most frequent sites followed by distal tibia, femur neck, intertrochanteric femur fracture; fractures of both bones in the forearm (Radius and Ulna) are the least frequent (4.35%).
 - 58.3% of the bacteria that were isolated were gram-positive, and 41.7% were gram-negative. Bacteria were primarily non-motile, with motile bacteria making up the remaining one-third.
 - All isolated bacteria were aerobic, and there was no anaerobic growth on bacterial cultures.
 - On laboratory culture, a single type of bacterial colony grew most frequently (79.7%), and multiple bacterial colonies were seen in 20.3% of the remaining cases. Those with open fractures had a higher rate of multiple bacterial growths.
- Staph. Aureus (53%) was the most prevalent bacteria in the current study, closely followed by E. coli (16.7%) and Pseudomonas aeruginosa (13.0%), Klebsiella pneumoniae, Proteus vulgaris. 5 other bacteria include Staphylococcus epidermidis, Staphylococcus saprophyticus. All bacteria confirmed biochemically.
 - About 15% of isolated bacterial strains were resistant to several first-line antibiotics and a few second-line antibiotics.

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