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Dr. Aniruddh Dash
Professor, Department of
Orthopaedics, IMS and SUM
hospital, SOA University, K8,
Kalinga nagar, Bhubaneswar,
India

Dr. Subrat Mohapatra
Assistant Professor, Department
of Orthopaedics, IMS and SUM
hospital, SOA University, K8,
Kalinga nagar, Bhubaneswar,
India

Surveillance of bacterial infections and their antibiotic resistance patterns in orthopaedic trauma surgeries at a tertiary care teaching hospital

Dr. Aniruddh Dash and Dr. Subrat Mohapatra

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Abstract

Introduction: Surgical site contaminations (SSIs) still reason huge horribleness and mortality in spite of advances in injury care. We have considered right now pace of SSIs, their results in patients experiencing mediations for injury and SSI inclines in creating nations.

Materials and Methods: One study (January, 2018 to December, 2018) was done. Patients experiencing intercessions for orthopedic injury were followed and evaluated for SSIs and their results and antimicrobial affectability examples of the smaller scale life forms separated were noted and associated.

Results: A sum of 40 (4.4%) affirmed instances of SSIs were distinguished among 746 patients of orthopedic injury. In light of the new CDC criteria, in the wake of precluding cellulitis, just 24 (2.6%) were found to have SSIs. A sum of 12.5% of the SSIs were identified during development. *Acinetobacter baumannii* was the prevalent life form as likewise *Staphylococcus aureus*. Results watched remembered changes for anti-microbial system, amendment medical procedure, readmission to emergency clinic and passing's.

Conclusions: SSI is pervasive in orthopedic injury patients and a functioning observation program will help in early administration and avoidance.

Keywords: Antibiotic resistance, orthopaedic surgery, surgical site infections, surveillance, trauma

Introduction

Careful site contaminations (SSIs) represent roughly 20% of all emergency clinic related diseases (HAIs) and speak to the second-most regular kind of HAIs in United States ^[1]. From 1986 to 1996, medical clinics leading SSI reconnaissance in the National Nosocomial Infections Surveillance (NNIS) framework revealed that there were 15,523 SSIs following 593,344 activities (CDC, unpublished information) ^[2]. An investigation demonstrated that SSIs were the most widely recognized nosocomial disease among careful patients, answerable for 38% of every single such contamination ^[2]. These reason huge bleakness, inabilities, antagonistic careful results, expanded social insurance costs and now and then lead to deadly results. Other than this, the pressure and nervousness endured by the patient and their families can't be measured ^[3, 4, 5], most of SSIs are brought about by the patient's own colonizing or endogenous greenery ^[6]. The causes and hazard factors for SSIs are shifted. Injury patients are an extraordinary accomplice of transcendently youthful guys, with no fundamental ailments (as a rule) and in the prime of their monetarily gainful age. Vehicular mishaps in creating nations are on the ascent. The vast majority of these conceded injury unfortunate casualties require careful mediations eventually putting them in danger for SSIs. SSIs announced in various kinds of medical procedures shift broadly. One potential factor representing such wide uniqueness in SSI rates is the utilization of various case meanings of SSI. Prior to 2010, instances of cellulitis could have been considered SSI cases as indicated by the 4 th Centers for Disease Control and Prevention (CDC) rule: A doctor analysis of contamination. Be that as it may, SSI now has another definition from CDC ^[2]. The effect of barring cellulitis was surveyed and later avoided from this definition. The definition determines that contaminations ought to create inside 30 days of medical procedure (if no embed was surrendered set up or over to 1 year with an embed) for it to be called as SSI ^[7].

Corresponding Author:
Dr. Subrat Mohapatra
Assistant Professor, Department
of Orthopaedics, IMS and SUM
hospital, SOA University, K8,
Kalinga nagar, Bhubaneswar,
India

However, this update explicitly prohibits cellulitis as a shallow incisional SSI, making the meaning of SSI progressively stringent and prohibitive. Inconveniences because of orthopedic SSIs run from shallow diseases to profound situated organ space contaminations. The latest National Healthcare Safety Network (NHSN) report, which incorporates information from 2006 to 2008, indicated that post knee substitution contamination rates go from 0.68% to 1.60%, contingent upon persistent hazard, and hip substitution disease rates run from 0.67% to 2.4%.^[8] The general pace of careful site disease after open decrease and inward obsession of tibial level breaks during the 7 years of this investigation was 7.8% (20 of 256)^[9]. Orthopedic medical procedure much of the time includes the position of an embed and henceforth its related contaminations^[10]. In perspective on the genuine unfriendly ramifications of orthopedic SSIs, anticipation and customary reconnaissance should be expanded which is particularly required for creating nations like India. A large number of the instances of SSIs are lost to catch up on release. Post-release follow-up of SSIs is critical to learn the greatness of the issue in orthopedic injury. This investigation portrays the pattern of SSIs in orthopedic injury at a tertiary care teaching hospital, Bhubaneswar as additionally its pattern in creating nations.

Materials and methods

This investigation was a planned observational examination. All post-usable patients over a multi month time span were observed by the specialists, microbiologists and clinic contamination control medical attendants for improvement of SSI (Jan 2018 to Dec 2018). Additionally, the sort of damage and careful mediation done were recorded and followed. An aggregate of 3,078 patients conceded during this period for orthopedic injury were screened and 746 were seen as potential possibility for the examination. Institutional survey board endorsement for the examination was acquired and composed, educated assent was taken from these patients.

A case was characterized as any patient who had been conceded for any orthopedic injury (CDC criteria) [2] and had experienced control or medical procedure identified with it right now, later created purulent release at the activity site or purulent release with microbiologically positive societies or signs and indications of fever alongside a noteworthy ascent in absolute leucocyte tallies after the medical procedure alongside culture inspiration or any indication of aggravation with expanding of incisional site, bombed join/embed with release yet nonappearance of negative culture and clinical/specialist's determination of SSI.

For those patients falling under clinical/specialist's finding of SSIs, cautious thought was done to preclude unadulterated cellulitis all things considered patients were rejected from the investigation and were treated with anti-microbials as it were. Patients were incorporated according to the case definition. The individuals who had been dealt with or worked outside the inside, yet later alluded here or who were on outer fixators were barred as likewise the individuals who created cellulitis. Co-morbidities, for example, diabetes mellitus, hypertension, renal or liver illnesses were additionally avoidances. Every one of these patients were painstakingly followed with respect to their length of medical clinic remain, method of treatment, careful mediations done, kind of inserts, any adjustment in their treatment system, wound condition, and so on. The antimicrobial treatment given pre-operatively and other administration methods were noted. Suitable examples were taken from the injury and microbiological societies were

proceeded according to the standard conventions, in light of the clinical judgment of the treating doctors. Aseptically gathered examples from the injury were handled for microbiological culture and affectability. Rehash tests were taken following seven days. Examining was likewise continued relying upon the injury condition and purulent release. The adjustment in the injury microbiological verdure was noted with its affectability design. The example preparing for analysis of bacterial and contagious pathogens was finished by standard techniques.^[11, 12] The bacterial confines were distinguished by the VITEK 2. The antimicrobial vulnerability testing was finished by the circle dissemination technique, as per the CLSI rules^[13, 14] and the VITEK 2 framework. An unequivocal arrangement of antimicrobials for both Gram-negative and Gram-positive microbes was tried. At first, all first line antimicrobials were tried and on the off chance that a separate was seen as impervious to them, at that point second line anti-microbials including colistin and tigecycline were tried. Multi-sedate obstruction was characterized by O'Fallon *et al.*^[15] An empiric system was begun on such patients as injury patients are viewed as conceivably contaminated and are later moved to a progressively explicit system relying upon the smaller scale living being secluded and its affectability report. In view of the emergency clinic anti-toxin strategy, empiric treatment was normally begun with parenteral Augmentin (amoxicillin/clavulanic corrosive) alongside aminoglycosides as well as metronidazole and later moved to increasingly explicit antimicrobials relying upon the affectability report. Be that as it may, aminoglycosides were utilized carefully or maintained a strategic distance from in serious injury patients because of its potential nephrotoxicity in a hypovolemic patient in danger of renal deficiency. The treating orthopedic group was hinted with respect to microbiological and antimicrobial affectability example to control in the further administration. All patients were firmly observed and the state of their injuries and the advancement of SSIs was talked about and noted. Changes in treatment conventions like amendment medical procedure or change in antimicrobial treatment or evacuation of inserts were noted in patients who had been determined to have SSI during the emergency clinic remain. The patients' status and wound conditions were noted at the hour of release. Every single such patient were called routinely for development and their conditions noted. Telephonic contact was kept up with patients living outside the city and who couldn't development. They were made mindful of their way of life results and encouraged to go to the facility for additional development and care. Due consideration was taken during incorporation to forestall duplication of situations where a released quiet must be readmitted. During the follow-up of such patients, different parameters were recorded, for example, state of the injury, release from the injury, disappointment of embed or expanding of the cut site, and so forth. This was done to take note of what number of patients had sound injuries at release however later created SSIs identified with their orthopedic mediations. Any adjustment in the antimicrobial treatment was likewise noted. All information was examined, looked at and broke down utilizing elucidating insights.

Results

A sum of 746 orthopedic injury patients were seen during this time span, of which 596 (70%) were guys and staying 256 (30%) were females (2.1:1). The mean age was 29.5 (± 10.5) years. Of the aggregate, 84% were unadulterated orthopedic

injury patients where intercessions were performed and the rest (16%) had other careful or neurosurgical strategies other than orthopedic medical procedure.

Orthopedic SSI rates

Counting unequivocal instances of cellulitis, an aggregate of 40 cases were distinguished in 914 worked locales among 852 patients. In this way, the pace of orthopedic SSI comprehensive of cellulitis was 4.4% per worked site. At the point when cellulitis was rejected from the examination, just 22 cases meeting at any rate one of classifications of CDC (1-3) were found. Among them, 14 patients had purulent release (CDC class 1), five patients had positive societies (CDC classification 2) and three patients had indications of irritation and expanding of the cut site. In this way the pace of SSI as

per the modified meaning of CDC was 2.6%. Out of the 40 SSIs, 18 (45%) were delegated classification 4 (specialist's conclusion) in view of the old CDC criteria. Of these 18 patients, 16 of them had cellulitis without purulent seepage or opening of the injury and settled with anti-microbial treatment, in spite of the fact that clinic affirmation with intravenous anti-toxins was required in six patients. The staying two patients had cellulitis with opening of the injury, and societies got were negative yet had been gone before by anti-infection treatment and subsequently were sorted as doctor determination both by the old and new CDC criteria. A two overlay decrease in orthopedic SSIs from 4.4% to 2.6% was watched if the specialist's conclusion of positive cellulitis was determined [Table 1].

Table 1: Proportions of Orthopedic SSIs with CDC reporting criteria

CDC category	CDC reporting guidelines before 2010	(%)	CDC reporting guidelines as of 2010	(%)
1	12	30	9	40.91
2	7	17.5	8	36.36
3	5	12.5	4	18.18
4	16	40	4	18.18
Total	40	100	22	100.00

Duration of hospitalization

On a normal, the middle span of medical clinic remains among those patients who didn't create SSI was 15 days (5-25 days). [Table 2] shows the term of clinic remain and intercessions done on the 24 patients who later created SSIs. The most brief remain of 20 days was seen among those with unadulterated orthopedic upper appendage injury. It was seen that 14 (58%) created purulent release, 6 (25%) had redness and erythema of the site, 4 (17%) of them had expanding of the entry point site and needed to experience correction medical procedure. A sum of 21 (87.5%) grumbled of serious agony at the worked site and required treatment audit (Table 2). Of the 24 SSIs patients, 16 patients (%) created SSI identified with orthopedic mediation inside 30 days of the medical procedure; the staying eight created SSI following 30 days however inside 1 year of medical procedure. The middle time to SSI finding was 14 days (scope of 7-64 days) with 12 (half) patients creating SSI inside the initial 14 days of

medical procedure. Be that as it may, there was no critical contrast so as to contamination in those patients giving unadulterated cellulitis versus different classifications of SSI. It was seen that the pace of contaminations was more during July-September, which for the most part have the most noteworthy quantities of affirmations moreover. A sum of 46 disengages were acquired. Multidrug opposition (MDR) among Gram-negative microbes was characterized as protection from at least three antimicrobials or antimicrobial gatherings including expanded range penicillins (ampicillin/sulbactam or piperacillin/tazobactam), cephalosporins (cefazolin or ceftriaxone), gentamicin, ciprofloxacin, and trimethoprim-sulfamethoxazole (TMP/SMX) [15]. [Table 3] shows the subtleties of the microbiological societies. Along these lines, it was seen that dominant part of the living beings were MDR with the exception of *Enterobacter* spp. furthermore, *Streptococcus* pyogenes.

Table 2: showing the various surgical interventions along with the patient's mean hospital duration

Trauma diagnosis at admission	Mean duration of hospital stays in days (range)	Surgical interventions done	Clinical feature (fever) (%)
Pure orthopedic upper limb trauma N=3	20 (10-30)	ORIF (67%), implants (33.3%), debridement (100%), grafting (66.7%)	33.3
Pure orthopedic lower limb trauma N=10	37.5 (25-50)	ORIF (80%), nailing (60), plating (40), grafting (30), debridement (9), revision surgeries for failed/infected implant	50
Combined upper limb and lower limb trauma N=6	39 (26-52)	ORIF (66.7), nailing (50), debridement (83.3)	66.7
Head, neck and spinal trauma, pelvic trauma N=2	62.5 (35-90)	Laminectomy (50), ORIF (100), CRID (50)	50
Joint surgeries N=1	35 (30-40)	NA	100
Combined orthopedic surgeries along with other surgical or neurosurgical interventions N=2	44 (28-60)	NA	100

Of the 40 SSI patients (inclusive of cellulitis), all were treated with antibiotics; 22 (55%) of whom were treated with oral antibiotics only, 16 (40%) with both oral and intravenous antibiotics and two (5%) with intravenous antibiotics only. Out of the 40 patients, 32 (80%) underwent debridement, 12 (30%) had to undergo drainage in the operating room or in the OPD and 15 (37.5%) patients had to undergo revision surgery or removal of the implant. A total of 5 (12.5%) patients were

diagnosed after they came back with discharge, gaping wounds or failure of implants. Of the total 40 patients, two died during treatment due to complications of SSI (both male). One of them was operated for multiple fractures of both the upper limb and lower limb and had an associated pelvic fracture; the second patient had undergone hip arthroplasty and later developed SSI.

Table 3: Microorganisms isolated from the various samples along with its antibiotic sensitivity pattern

Organisms isolated	Sensitive antibiotics	Resistant antibiotics
<i>Acinetobacter spp.</i> (10)	Colistin	Chloramphenicol, carbapenems, penicillins, netilmicin, fluoroquinolones, tetracycline, tigecycline, cephalosporins, TMP/SMX
<i>Klebsiella spp.</i> (8)	Colistin, tigecycline	Chloramphenicol, carbapenems, penicillins, netilmicin, fluoroquinolones, tetracycline, cephalosporins, TMP/SMX
<i>Pseudomonas spp.</i> (8)	Colistin	Chloramphenicol, carbapenems, netilmicin, penicillins, fluoroquinolones, tetracyclines, cephalosporins, IMP/SMX
<i>Escherichia coli</i> (6)	Netilmicin, carbapenems, aminoglycosides	Chloramphenicol, penicillins, fluoroquinolones, tetracyclines, cephalosporins, TMP/SMX
<i>Citrobacter spp.</i> (2)	Fluoroquinolones, tetracyclines, netilmicin, carbapenems	Aminoglycosides, chloramphenicol, cephalosporins, penicillins, TRAP/SMX
<i>Enterobacter spp.</i> (1)	netilmicin, carbapenems, fluoroquinolones, aminoglycosides, chloramphenicol, tetracycline	penicillins, chloramphenicol, aminoglycosides, tetracyclines, cephalosporins, fluoroquinolones, TMP/SMX
<i>Providencia spp.</i> (1)	Cefepime, netilmicin, trimethoprim sulfamethoxazole, carbapenems	penicillins, oxacillin, ceftiofloxacin, ampicillin/sulbactam, amoxicillin sulbactam, erythromycin, clindamycin
<i>Streptococcus pyogenes</i> (2)	Sensitive to all the antibiotics used for Gram positive	No
<i>Staphylococcus aureus</i> (8)	Linezolid, vancomycin, teicoplanin, rifampicin, quinupristin/dalfopristin, fluoroquinolones, rifampicin, netilmicin	penicillins, oxacillin, ceftiofloxacin, ampicillin/sulbactam, amoxicillin sulbactam, erythromycin, clindamycin

Discussion

SSIs in orthopedic medical procedure are not obscure. Our investigation discovered male power (3:1) in SSI. Our finding was in concordance with another investigation which additionally indicated male transcendence [16]. However, this might be because of higher confirmation paces of guys to injury care offices. In our investigation, the all-out SSI rate was 2.6% dependent on the new meaning of SSI. This finding was nearly at standard with SSIs seen in orthopedic medical procedures in created nations [17, 18, 19] however lower than the rates found in some creating nations. [20, 21] This may mirror the standard of care at our medical clinic, and the consolidated impact of accessibility of ultra-tidy up ventilated activity rooms and the establishment of cutting-edge injury life support (ATLS) conventions at our middle. Of course, in an investigation from Serbia, the occurrence pace of SSI was 22.7% as they had included unadulterated cellulitis patients. [16] The creators in that review had likewise stratified the patients as per twisted condition on affirmation in which over 70% of the injuries were either sullied or messy/tainted injuries [16]. In our examination, 80% of the injuries were either debased or filthy.

The vast majority of the SSI falls under shallow incisional SSI which incorporates the unadulterated cellulitis cases (30%). About 32.5% fall under profound incisional SSI and staying in organ/space SSI.

As an outcome of an expanding pattern of shorter medical clinic remain, larger part of SSIs happen after release from the emergency clinic [22]. It was additionally found in our examination that 12.5% of the SSI analyzed were gotten during development. This additionally shows a decent SSI counteraction group is required to effectively hold such patients under reconnaissance and analyze and treat every single new instance of SSI.

Gram-negative microbes like *Acinetobacter baumannii*, *Klebsiella pneumonia* and *Pseudomonas aeruginosa* re saw as the dominating living beings capable. Of Gram-positive microbes, *Staphylococcus aureus* was maximally liable for causing SSIs in our investigation rather than different examinations [16, 21] Although nasal carriage of *S. aureus* can be successfully destroyed by mupirocin, our investigation has indicated that it may not altogether lessen the general pace of SSIs, [23] as Gram negatives additionally structure a significant lump of living beings dependable.

Our investigation shows that diseases can draw out the medical clinic remain and increment the bleakness and mortality [11, 14, 24]. Also, we found that the pace of contaminations was higher during July to September, which ordinarily have the most noteworthy quantities of affirmations. The higher paces of SSIs during these months might be because of the way that more medical procedures are performed under crisis conditions to meet the heap and the for the most part moist and hot conditions winning around then. A committed disease control unit which can forcefully screen such conditions is the need of great importance. Legitimate recognizable proof and hazard evaluation of orthopedic patients should be done alongside pre-employable administration of the dangers factors included. A significant restriction of this investigation is that we didn't contemplate the factors influencing the advancement of SSI.

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