Original Article

Patterns of Antimicrobial Use in a Specialized Surgical Hospital in Southeast Nigeria: Need for a Standardized Protocol of Antimicrobial Use in the Tropics

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Abstract

Background: Antimicrobial resistance remains a growing global health menace. One of the key actions to curb this menace by the World Health Organization is antimicrobial stewardship (AMS). A prescription protocol is one of the cost-effective AMS interventions in surgery. This study determines the patterns of antimicrobial usage in a hospital specialized in orthopedic and plastic surgeries care in Nigeria. **Methods:** A cross-sectional survey was carried out at National Orthopaedic Hospital Enugu, a tertiary hospital specialized in orthopedic and plastic surgeries in Southeast Nigeria in May 2019. All the inpatients were included in the study. A standardized tool for point prevalence survey was used to collect data. Data were analyzed using Epi Info version 7.2.4. **Results:** A total of 127 inpatients participated in the survey with 387 antimicrobial encounters. The most common reasons for antimicrobial use were for the treatment of community-acquired infections (65.0%) and prophylaxis (29.4%). The decision for their use was made majorly on an empirical basis (92.4%). The reasons for antimicrobial prescriptions were documented in the majority (97.5%) of the cases and stop review dates in all (100%) of the prescriptions. Ceftriaxone (25.7%), tinidazole (21.9%), and metronidazole (14.6%) were the commonest antimicrobials prescribed among the patients. **Conclusion:** Orthopedic and plastic surgery practices require tailored prophylactic antibiotic regimens in the tropics due to peculiarities of both the specialties and the subregion. The claim that existing protocols in the temperate regions may apply in the tropics has been questioned due to the microbial profile on the tropics.

Keywords: Antimicrobial protocol in surgery, antimicrobial resistance, antimicrobial stewardship, prophylactic antibiotics

Introduction

Antimicrobial resistance (AMR) is recognized globally as a threat to public health.[1] This is due to the ageless battle against microbes, especially bacteria which has increasingly led to resistance to almost all antimicrobials available. Global and national policy initiatives have acknowledged that excessive and inappropriate antimicrobials use are major contributors to antibiotic resistance, and that there is a need to improve the antimicrobial use through antimicrobial stewardship (AMS).[1] AMS is a group of interventions aimed at improving antibiotic use. It is an important part of efforts to control antibiotic resistance according to the World Health Organization.[2]

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AMS programs are known to improve antimicrobial use, patient outcomes, lower the risk of developing resistance, lower the rate of health-care-associated infections, and reduce the cost of treatments among others.[3,4] AMS, infection prevention and control, and patient safety are the

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three pillars of an integrated approach to health systems strengthening.[5]

Stewardship interventions can be structural, persuasive, enabling, or restrictive. In structural intervention, a new diagnostic test could be introduced to guide antibiotic use. The use of prescription audit and feedback is a form of persuasive AMS, whereas providing education to the prescribers on the appropriate use of antimicrobial could be seen as enabling. In some cases, a restrictive approach could be used where some agents are reserved and used only within well-defined conditions.[3] A combination of these interventions can make up a hospital antimicrobial/antibiotic stewardship.

A recent systematic review of antimicrobial use and AMS shows a lack of adequate data and studies from sub-Saharan Africa, especially Nigeria.[6] This study aims to survey the patterns of antimicrobial use in a tertiary Orthopaedic and Plastic Surgery hospital in Southeast Nigeria. The study will form the basis for prioritizing AMS hospital programs that will help curb the AMR menace, especially in low- and middle-income countries.

Methods

Ethical consideration

Ethical approval was obtained from the Institutional Review Board of National Orthopaedic Hospital Enugu (NOHE).

Study area

This study was carried out in NOHE. This is one of the three government orthopedic hospitals in Nigeria. It is situated in Enugu State and strategically located to serve Nigerians residing in the Eastern and Southern flanks of the country. It is a 240-bed specialist hospital providing orthopedic, trauma, and plastic surgery services. It has a regional trauma/burns Center and a comprehensive laboratory. Five full-time consultant plastic surgeons run three units and 14 orthopedic surgeons run six orthopedic units. There are sixty residents (trainee surgeons), 15 consulting clinics running Monday to Friday. The hospital operates five theaters, one dedicated to orthopedics, one to plastic surgery, both specialties share the trauma, septic, and general theaters. The hospital does not have a written antibiotic guideline.

Routinely, patients presenting with open fractures/wounds are put on cephalosporins and imidazoles though not a written policy. Patients with open fractures are seen by both orthopedic and plastic teams in their emergency rooms.

The bed occupancy rate on the day of the survey was 52.9% (127/240).

Study design and population

A cross-sectional survey of all the inpatients in the wards in May 2019 was carried out. Inpatients in the wards at 08:00 h of the survey day were included.

Study instruments

We used the standardized tool developed by the University of Antwerp "https://www.global-pps.com" for assessing antimicrobial point prevalence to collect information from the patients' hospital records. Patients' demographics, laboratory use, antimicrobial indications, stop review date, and reasons for antimicrobial use were collected. Malaria is endemic in the study area and accounted for the inclusion of antimalarials in the antimicrobial spectrum (antimalarials are not necessarily antibiotics).

Data analysis

Data collected with the standardized tool developed the University of Antwerp "https://www.global-pps.com," was analyzed using Epi Info version 7.2.4 Frequencies were calculated and results presented in tables and chart.

Results

A total of 127 inpatients participated in the survey, and of these, 120 were admitted in the adult surgical ward, six in the pediatric surgical ward, and one in the adult intensive care unit. A total of 106 (83.5%) of the participants were on one antimicrobial or the other during the survey. Ninety-six (90.6%) inpatients were above 18 years of age. Seventy-two (67.9%) patients were males, and the most common age groups were 25–34 years, then >50 years categories [Table 1]. There were a total of 357 antimicrobial encounters. The maximum number of antimicrobials a patient was receiving was eight (median: 4; interquartile range: 3, 5).

The most common reasons for antimicrobial use were for the treatment of community-acquired infections (65.0%) as against hospital-acquired (nosocomial) infections (5.3%)] and for prophylaxis (29.4%) [Table 1], and the decision for their use was made majorly on an empirical basis (92.4%) as against targeted antimicrobial prescription (7.6%) [Table 2]. The reason for antimicrobial prescriptions was documented in the majority (97.5%) of the cases and stop review dates in all (100%) of the prescriptions.

Table 1: Sociodemographic characteristic of the patients and reasons for antimicrobial use

Variable	Frequency (%)
Age (years)	
<18	10 (9.4)
18-24	11 (10.4)
25-34	27 (25.5)
35-44	19 (17.9)
45-54	12 (11.3)
>55	27 (25.5)
Sex	
Male	72 (67.9)
Female	34 (32.1)
Reasons for antimicrobial use	
Community acquired infection	232 (65.0)
Hospital acquired infection	19 (5.3)
Prophylaxis	105 (29.4)
Unknown	1 (0.3)

The duration of prophylactic antibiotic usage was more than 24 h in 101 (96%) of the patients on prophylaxis. Two patients (2%) had prophylaxis for 24 h and the remaining 2% had it for <24 h too.

The common antimicrobial use by indications is portrayed in Table 3. Table 4 and Figure 1 show the diagnoses, for which antimicrobials were used, and the antibiotics that were commonly prescribed in the study hospital. The most common antimicrobials prescribed for treatment were ceftriaxone (26.3%), tinidazole (22.0%), and metronidazole (15.5%) for community-acquired infections; ceftriaxone (28.6%), tinidazole (23.8%), and metronidazole (15.2%) for prophylaxis and artemether/lumefantrine (31.6%), artemether (15.8%), and tinidazole for hospital-acquired infections, respectively.

Table 2: Antimicrobial prescription quality indicators

Variable	Frequency (%)
Treatment	
Empirical	330 (92.4)
Targeted	27 (7.6)
Reason in note	
Yes	348 (97.5)
No	9 (2.5)
Guideline compliance	
Yes	19 (5.3)
No	1 (0.3)
NA	337 (94.4)
Stop review date documentation	
Yes	357 (100.0)
No	0
Route of administration	
Oral	129 (36.1)
Parenteral	228 (63.9)

NA: Not applicable

Table 3: Common antimicrobial use by indication

Variable	Frequency (%)
Community acquired infection	
Ceftriazone	61 (26.3)
Tinidazole	51 (22.0)
Metronidazole	36 (15.5)
Cefuroxime	19 (8.2)
Levofloxacin	14 (6.0)
Hospital acquired infection	
Artemether and lumefanterine	6 (31.6)
Artemether	3 (15.8)
Tinidazole	2 (10.5)
Amoxicilling and enzyme inhibitor	1 (5.3)
Prophylaxis	
Ceftriaxone	30 (28.6)
Tinidazole	25 (23.8)
Metronidazole	16 (15.2)
Cefuroxime	6 (5.7)
Gentamicin	6 (5.7)

Discussion

The antimicrobial use in orthopedic and plastic surgeries is often more aggressive than in other fields of surgery because the consequences of infections can be disastrous. Bone infection is considered the most dreaded complication of orthopedic surgery.[7] The point prevalence of antimicrobial use, though high (83.5%) is similar to what obtains in the subregion.[8,9] The use of antibiotics for prophylaxis is also slightly favored toward prolonged duration. There is a varied range of practices in the duration of administration of prophylactic antimicrobials, ranging from a single dose to as much as 14 days postoperatively.[10] This pattern varies with the findings in tertiary hospitals that covered more than just surgical cases,[11] where their point prevalence of antimicrobial use was much lower (44%).

We observed a high level of the antimicrobial prescriptions were given empirically (92.4%) and mainly for community-acquired infections. The most common diagnosis was soft tissue, and skin infections followed by bone and joint infections. This may be explained by the fact that the hospital is dedicated mainly to plastic and orthopedic surgeries. The use of empirical antibiotics in patients with burn injuries and other soft-tissue trauma stems mainly from the fear of overwhelming infection. Owing to poor transport and emergency services, patients are most likely to present outside the golden hour and with contamination of the wounds.[12] Besides, the lack of adequate spacing and ward design make breaks in the aseptic techniques more likely, encouraging the physicians to lean on antibiotics.

Other infections noted in the study can be explained as nosocomial infections. They were relatively low occurrences. Sepsis and upper respiratory tract infection are known complications of surgical patients acquired as nosocomial infections. Few other nosocomial infections (urinary tract, pneumonia, and gastrointestinal infections) were observed. The choice of antibiotics for their treatment commonly falls within

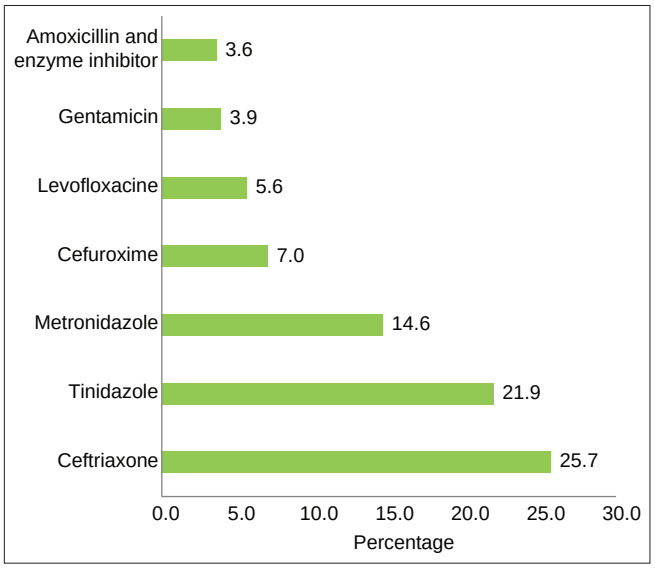

Figure 1: The most common antimicrobials prescribed among the patients

Table 4: Ten most common diagnoses treated with therapeutic antimicrobial

Diagnosis	*n* (%)
Skin/soft tissue infection	49 (52.1)
Bone and joint infection	19 (20.2)
Malaria	17 (18.1)
Sepsis	3 (3.2)
URTI	2 (2.1)
Cystitis	1 (1.1)
GI infection	1 (1.1)
HIV	1 (1.1)
Pneumonia	1 (1.1)

URTI: Upper respiratory tract infection, GI: Gastrointestinal

the available local antimicrobials that are also used in plastic and orthopedic practices. Malaria is endemic in the study area. It was the third most common diagnosis and accounted for the inclusion of antimalarials in the antimicrobial spectrum.

Antimicrobial Prescription Quality indicators: There was commendable documentation of reasons for prescriptions (97.5%) and stop review date (100%). These findings have been found in some studies in the same region.[8,9] These should be sustained as it portrays good AMS. However, the majority (92.4%) of the prescriptions were empirical with the most used for prophylaxis. This portrays a very low level (7.6%) of targeted antimicrobial use, in the study area, and calls for an urgent need for improved AMS to avoid the disaster of AMR in this specialized hospital. This finding did not differ from the report in other bigger tertiary hospitals in Africa with more clinical subspecialties than just surgery.[8,11,13]

Third-generation cephalosporin (Ceftriaxone) was the most prescribed antimicrobial, followed by the imidazoles (tinidazole and metronidazole), then the second-generation cephalosporin (cefuroxime). The use of quinolones, aminoglycosides, and ampicillins were less pronounced. The choice of antimicrobial was not based on any guidelines. Availability, best guess, and cost must have contributed significantly to their choices, as prescription based on antibiotic sensitivity was not the common practice noted in the study. The antimicrobials were used mostly for surgical prophylaxis and community-acquired infections. The prophylactic use may have contributed to the high parenteral route of administration observed as this is usually given or commenced at the induction of anesthesia. These findings are similar to what had been reported in earlier studies,[8,9,11] even though these studies involved other specialties in medical practice. The need for a review of antimicrobial use, to improve AMS while sustaining some prescription quality indicators, is very overt in our study. This is much more important in plastic and orthopedic surgery practices where AMR may be very disastrous, especially in implant surgeries.

We also observed that as much as 96% of patients receiving prophylactic antibiotics had it beyond 24 h. This practice of giving prophylactic antibiotics beyond 24 h is not limited to the center as other centers in the country and other countries in the subregion give it beyond 24 h.[9,14] A reason adduced for this was that tropical region being hot and humid support bacterial colonization of both wounds and fomites.[7] Our study center being a tropical hospital may have imbibed this age-long practice from anecdotal observations. This practice is riddled with lots of controversies with some insisting that a clean theater is all that is necessary to prevent infection and others positing that even an ultra-clean theater does not suffice, especially where an implant is used.[10,15] In orthopedic and plastic surgeries, the use of implants is very common. This might have been responsible for the protracted antibiotic prophylaxis in the survey. In a multicenter study involving three tertiary hospitals in northern Nigeria, only 22.5% of the antibiotics prescriptions were made for surgical prophylaxis.[16] This is slightly lower than the prophylactic antibiotics observed in this specialized plastic and orthopedic center. This difference in prophylactic antibiotics prescription may be related to the peculiarities in orthopedics and plastic surgeries. It could also be related to the use of the presumptive antibiotics which is commonly employed in trauma, especially in settings of open fractures.[9,17]

It is, therefore, necessary to develop a prophylactic guideline that is tailored to orthopedics and plastic surgeries in this setting. Such guidelines would be able to address the peculiar microbial profile of the tropics and the sensitive nature of plastic/orthopedic practice in this subregion. Extended prophylactic antibiotics have been suggested to be sustained till epithelial tissue covers the surgical wound.[7] Even in the temperate regions, variations have been observed in the pattern of organisms encountered and antibiotics used.[18] Each region or subregion should undertake the responsibility of developing a specialty-based region-specific guidelines on prophylaxis. The traditional teaching has been to resort to broad-based antibiotics. This does not take into cognizance of the fact that broad-spectrum antibiotics lead to resistance which is a feared complication of antibiotics abuse.[19]

The experience of surgeons in the subregion may have informed the perceived unwillingness to adopt the traditional prophylactic regimen.[20] Despite the knowledge of the traditional concept, extended use of antibiotics to an average of about seven days has been common.[21] A case for presumptive antimicrobial use has been made in the region.[9] This can cover for trauma cases, the same cannot be said for an implant, and aesthetic surgery cases. A review of this practice viz-a-viz a comparison with the conventional <24 h regimen is necessary. This survey captured patients who were on prophylactic, presumptive as well as therapeutic antimicrobial use. Therefore, there is a need to develop a standardized guideline in the subregion for orthopedic, plastic, and trauma surgery antimicrobial use.

Limitations

This was a single-center study. We did not assess the peculiarities of implant versus nonimplant procedures.

Conclusion

Orthopedic and plastic surgical practices require tailored antimicrobial protocol in the tropics due to peculiarities of both subspecialties and the subregion. While this is still awaited, the practice of extended antibiotic prophylaxis remains the practice guided by fear of disaster from infections. The claims that existing protocols in the temperate regions may apply in the tropics have been questioned due to the microbial profile on the tropics. This, therefore, necessitates a tailored guideline for antimicrobial use in the tropical subregion, especially for some surgical subspecialties such as plastic and orthopedic surgeries.

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Conflicts of interest

There are no conflicts of interest.

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