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Review Article

Importance of antibiotic therapy in post-surgical patients

Anitta Pottananikkal[1,*], Athira Varghese[1], Sunitha Sam[1], Vineeth Chandy[1]

[1]*Dept. of Pharmacology, T John College of Pharmacy, Bengaluru, Karnataka, India*

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ABSTRACT

Antibiotics are the class of medication that prevent the infections that is caused by bacteria; antibiotics make it difficult to grow or multiply or directly killing them. But the widespread misuse of antibiotics can also lead to serious consequences. In the case of post-operative patients, the empirical antibiotics should be selected based on the site of infection, etiology, and pharmacokinetics of the antibiotics. Therefore, the rational use of empirical antibiotics is based on the increase in the total count and also the spike in temperature. The review focus on the time, duration, rationality, and selection of empirical antibiotics, and antibiotic prescription patterns in different departments and different age groups.

1. Introduction

Antibiotics are the class of medication that prevent the infections caused due to bacteria. Antibiotics make it difficult for the bacteria to grow and multiply or directly kill them. Antibiotics play a major role in the improvement of patient quality, especially in the areas of medicine and surgery, end-stage renal disease, rheumatoid arthritis, and cardiac surgery.[1] Antibiotics are the successful chemotherapeutic agents in medicines. The discovery of antibiotics; saves millions of lives.[2] However, the emergence of antibiotic-resistant pathogens mainly multi-drug resistant bacteria became a huge problem in healthcare.[3] Bacterial resistance can be defined as the ability of bacterial cells to fend off the bactericidal or bacteriostatic action of antibiotics. This can be due to natural resistance, acquired resistance, cross-resistance, multi-drug, and other types of resistance.[4] The widespread overuse and misuse of antibiotics lead to serious consequences.[5] Over the last few years, the abuse of antibiotic leads to resistance in pathogenic bacteria. This will make a slow progression in the plotting of new therapeutics and has caused a crisis in the treatment of easily curable diseases.[6] The empirical therapy should be considered as per the site of infection, anamnestic and epidemiological data about the probable etiology, sensitivity of the pathogens, and pharmacokinetic properties of the drug such as tissue metabolism, Followed by the choice of antibiotics mainly based on the type of organisms, host characteristics, and site of infection.[7] If the patient is given ineffective anti-infective therapy against the causative pathogens then it can influence the patient's outcome.[8] Antibiotics policy explains the indication, selection, dosing, route of administration, duration, and timing of antibiotics for the maximization of clinical cure and the prevention of infection.[9]

2. Selection of Empirical Antibiotic

2.1. Timing

The intensive care unit (ICU) patients will be associated with severe or life-threatening infections that are mostly of bacterial or fungal origin and requires antimicrobial therapy.

* *Corresponding author*.
E-mail address: anittaps15@gmail.com (A. Pottananikkal).

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The timing of antibiotics selection in the patients at ICU department will be based on the sepsis and septic shock. If the administration of the antibiotic is delayed in the case of patients with a serious infection lead to increase the severity. Not only the early administration of antibiotics that affects the outcome but also the selection of those agents.[10]

Gram-negative bacteremia is a common cause that largely seen in hospital-acquired sepsis. There will be a growth of aerobic Gram-negative bacillus in a blood culture. Within 30 days; 12% and 38% of the population die due to the infection. There was a survival analysis conducted among 789 patients with Escherichia coli, klebsiella, and pseudomonas aeruginosa bacteremia. The choice of antibiotics during blood culture, medical clerking, and 24-48 hours post-blood culture were reviewed. Patients who have received ineffective antibiotics are having a higher risk of mortality while taking the blood culture before 30 days.[11]

In a retrospective study of a total of 17,990 patients; they received antibiotics after the sepsis identification. This shows that the probability of death is associated with the number of hours of delay for the administration of the first antibiotic. And there is a chance of an increase in the risk of mortality if the administration of the antibiotic is delayed.[12] The use of antimicrobial agents at the proper time is the backbone of therapy, especially in the case of patients with sepsis. And the selection of empirical therapy in emergency department patients should be always considered in such a way that it can reduce the mortality associated with the complication.[13]

2.2. *Duration*

There are certain conditions where patients require prolonged antibiotic therapy. But it is associated with major problems like increased chance of resistance, medicalizing effects, and an increase in the total burden to the patient, and also adverse drug reactions.

The possible ways to reduce the duration of antibiotics therapy can be done by following methods; Stop antibiotics when not required, Not stop antibiotics when required, Keep the antibiotics' therapy as short as possible.[14]

In case of uncomplicated urinary tract infection, the current guidelines indicating about the duration of antibiotics; that is trimethoprim-sulfamethoxazole or ofloxacin given for 3 days, and nitrofurantoin for 5 days.[15]

Duration of antibiotic treatment can be selected according to pharmacokinetic and pharmacodynamics attributes of the particular anti-microbial utilized. The post-antibiotic impact is an evident pharmacodynamics experience that gives back the steady hindrance of bacterial widening following the removal of an active agent from the way of culture medium.[16]

Recent rules proposed that antibiotic treatment for hospitalized patients with local area gained pneumonia (CAP) can be decreased by individualizing treatment based on the clinical response of the patient. However, the utilization of this guideline in clinical practice is unknown. Duration of treatment was examined in patients distinguished from the community-acquired pneumonia organization data set and assessed for the seriousness of the disease on admission and time to clinical strength (TCS).[17]

2.3. *Dosing*

Effective antibiotics therapy is an crucial part of the management of sepsis patients. But more studies demonstrate that administration time has more importance than dosing of antibiotics.[18] The dose adaptation is a bit complicated because of the unpredictable dose–exposure relationship.[19] In the case of sepsis and the patient is critically ill. If the patient is a critically ill patient then the administration of the antibiotic should be early as possible for the effective antibiotics therapy.[20] The empirical antibiotics choice should be based on the site of infection, prior microbiology, comorbidities, the severity of illness, allergy profile of patients, and the development of the antibiotics resistance; and it should be informed to the patient before administration· Special consideration in the case of neonates, like the maximal efficacy and minimal toxicity, should be calculated.[21]

3. Rationality Behind the Selection of Empirical Antibiotic

In the last decades, there are many shreds of evidence that explain the antibiotic resistance in patients taking antimicrobial therapy and the reason behind this is natural and human-impacted environments.[22] So there is a need for educating our patients and community about the proper usage of antibiotics for the prevention of infection and the improvement of patients condition.[23] The development of antibiotic resistance in patients can ultimately increase the cost burden there is a relationship between the appropriate use of antibiotics, compliance, resistance, and regimen complexity.[24] The irrationality behind the administration of antibiotics leads to an increase in the morbidity and mortality rate worldwide. A comparative study before and after the implementation of antibiotics — use policy shows that there is a reduction in the cost, antibiotic–selective pressure, and resistance.[25] The selection of antibiotics in the intensive care unit (ICU) would be empirical and based on the critical nature of the patients.[26] Antibiotic selection depends on the most likely source of infection, the proper antibiotic treatment is essential for accomplishing the most ideal outcome.[27]

4. National Treatment Guidelines

The national treatment guidelines for antimicrobial use in infectious diseases explain the correct use of antibiotics according to the causative organisms.

4.1. Gastrointestinal

Bacterial dysentery: ceftriaxone 2mg IV OD for 5 days or oral cefixime 10-15mg / kg/ day for 5 days.

Amoebic dysentery: metronidazole 400mg oral TDS for 7-10 days

4.2. Central nervous system

Acute bacterial meningitis: ceftriaxone 2g IV 12 hourly/cefotaxime 2 g IV 4-6 hourly.

Brain abscess, subdural emphysema: ceftriaxone 2 g IV 12 hourly or cefotaxime 2 g IV 4-6 hourly.

4.3. Cardiovascular system

Infective endocarditis: penicillin G 20 MU IV divided dose, 4 hourly.

4.4. Respiratory tract infection

Community-acquired pneumonia: Amoxicillin 500mg — 1g TDS oral.

Lung abscess: piperacillin-tazobactam 4.5gm IV 6 hourly

4.5. Urinary tract infection

Acute uncomplicated cystitis: nitrofurantoin 100 mg BD for 7 days. Acute prostatitis: Dixieline 100mg BD or co-trimoxazole 960mg BD.[28]

The prevention of hospital-acquired infection in the hospital is a key part for assuring high-quality and safe healthcare. The main factors that contribute to the development of hospital-acquired infections are transmitted between the health workers and the patients, and irrational use of antibiotics for the infections conditions.[29] An antibiotics smart use (ASU) was the program that was introduced in Thailand, for the promotion of the rational use of antibiotics. Thereby assessed the intervention of the antibiotics therapy and the prescribing pattern of the antibiotics.[30] A prospective audit explains the compliance with the national guidelines; tells about only 87% of patients receive the antibiotics treatment according to the national treatment guidelines. And the patients were grouped into four groups according to their age and risk conditions. The guidelines for the rational use of antibiotics can be nationally or locally.[31]

5. Antibiotic Policy

There is a reasonable relationship between antibiotic use and resistance both on individual and populace levels. In the European Union, nations with huge antibiotic utilization have higher resistance rates.[32] The point of this study was to overview current treatment practice for normal diseases in essential consideration as a reason for the execution of late delivered evidence-based guidelines for community-acquired infection.[33] The development of protection from antibiotic is a significant issue around the world. The ordinary oropharyngeal flora, gastrointestinal flora, and skin verdure play an important role in the development. Within a few days after the beginning of antibiotic treatment, safe Escherichia coli, Haemophilus influenza, and Staphylococcus epidermidis can be distinguished in the typical flora of workers or patients.[34] The establishment of a reasonable anti-biotic strategy is a main point of contention for both better consideration of patients and battling antimicrobial resistance.[35] The guideline point of antibiotic policies is to achieve a change in recommending which will prompt diminished cost, decrease of obstruction and worked on quality (wise, protected and suitable) of antibiotic prescribing.[36] The drug specialist provides a vital role in the administration of antibiotic strategy. Consumers and payers request quality consideration at an essentially marked down cost. Physicians should be engaged with all periods of projects that are considered to be cost saving. These projects coordinate and archive both clinical and financial parts of care.[37] Up to this point, the clinical local area has appeared to be unequipped for responding to the inevitable emergency of antibiotic opposition. A few clarifications exist for this absence of activity, including the interaction between specialists, patients, and guardians over antibiotic use and the fact that the pharmaceutical industry has so far succeeded in developing new antibiotics when resistance to existing ones has emerged. Even though we need a superior comprehension of the variables engaged with the rise and spread of antibiotic resistance and the basics of better control of antibiotic resistance are well-known.[38]

6. Antibiotic Prescribing Pattern in Pediatrics

To determine the extent of kids getting antibiotics for normal sicknesses and to understand the antibiotic medicine and factors impacting it, a cross-sectional review was conducted among the confidential experts in Chennai, India 403 medicines by 40 doctors from chosen wellbeing offices were examined 79.9% of youngsters with ARI (Acute respiratory infection) and ADD (Attention deficient disorder) were prescribed antibiotics. Penicillin (43.9%) was the commonest antibiotic prescribed. Factors like postgraduate capability, the experience of the doctor, source and technique for refreshing information, ongoing work on setting, and presence of fever influenced the antibiotic prescription.[39]

Among the children who were admitted to the tertiary care hospital; the major problem associated was polypharmacy, high injectable use, and non-adherence.[40] The most common antibiotics prescribed for paediatric patients are ceftriaxone, and gentamicin, and the antibiotics selection is based on the culture and sensitivity test.

Cost for the long-term parenteral antibiotics can be minimized by converting to the proper oral antibiotics whenever possible.[41] The use of broad-spectrum antibiotics in case children is increasing day by day and that leads to the unnecessary cost and development of antibiotics resistance.[42] The resistance in the children is always associated because 50% of prescriptions written by the community-based practitioners are unnecessary.[43]

A study was carried out for 606 patients for 6 months in a tertiary care hospital in rural Gujarat. And analysed the average number of medicines per prescription, percentage of prescriptions presented by the generic name, the essential status of the medicines, appropriateness of the medicines used, and the cost of the medicines; the average medicines per prescription were about 3.7 and among the 606 patients the 46, 7 % patients are prescribed with 3 medicines ;and only 20.1% medicines was appropriate according to the children conditions.[44]

Children have a higher incidence of minor infections; they are associated with increased susceptibility to serious bacterial infections. And for that, the cephalosporin's are commonly prescribed for 1-5 days.[45]

7. Antibiotics Prescribing Pattern in Geriatrics

Updates and improvement of antibiotics local guidelines, better training of prescribers, this are the main points to be consider for the improvement of prescription of antibiotics in geriatric patients.

A review of prescription pattern in 142 patients; the antibiotics are mainly prescribed for the respiratory tract infection, urinary tract infection, skin infections, or abdominal infection. Among this half of the prescription was found as inappropriate, 32 prescription was inappropriate duration, 38 prescription was inappropriate spectrum of activity.[46]

The drug prescription pattern of antibiotics in the elderly patients are still not accurate. The suitable interventions should be implemented in case of healthcare providers and patients for the achievement of clinical outcome.[47]

7.1. Antibiotics prescription pattern in different departments Gastrointestinal

Post- operative complications are common in case of gastro-intestinal surgery, that can severe morbidity and also mortality. In the gastrointestinal surgery the patients undergoing elective operations; they are at the higher risk of this complications. Endogenous bacterial populations are the common causative micro-organism. Use of most appropriate antibiotics as a prophylactic and empirical has reduced the incidence of complications and also improved the patient's outcome.[48]

A retrospective unit-centric study on the acute calculous cholecystitis (ACC) shows that the patients who received adequate empirical antibiotics had a lower risk of complications than the ones who didn't received adequate empirical therapy. Thereby the incidence of mortality also reduced in such patients.[49]

8. Central Nervous System

Central nervous system infections are the most severe complications associated with the mortality and morbidity worldwide. The emergence of antimicrobial resistance and the incomplete knowledge about the pathogenesis became huge problem. Early therapy with the empirical antibiotics especially in the case of bacterial — meningitis is crucial for the management but the problem is still the early identification of the bacterial — meningitis is challenging.[50]

Acute bacterial meningitis and spinal epidural abscess are the main neurological emergencies that requires immediate empirical antibiotics regimen.[51] Penicillin, chloramphenicol, and aminoglycosides are main Antibiotics used in this department.[52]

9. Abbreviations

OD-Once daily, ICU-Intensive care unit, CAP-Community acquired pneumonia, TCS-Time to clinical strength, TDS-Three times of days, IV-Intra venous, MU-Milli unit, BD-Twice daily, ASU-Ambulatory surgery unit, ACC-Acute calculous cholecystitis.

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11. Conflict of Interest

There are no conflicts of interest.

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Author biography

Anitta Pottananikkal, Student (Research Scholar) https://orcid.org/0000-0002-2255-8203

Athira Varghese, Student Research Scholar https://orcid.org/0000-0002-2802-6566

Sunitha Sam, Assistant Professor

Vineeth Chandy, Principal

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