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APPROPRIATE ANTIBIOTIC USE IN PEDIATRIC RESPIRATORY INFECTIONS: BALANCING EFFICACY AND RESISTANCE

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ABSTRACT

Background

Pneumonia in children is widespread and is subject to antibiotic treatment. Nevertheless, excessive consumption of antibiotics may result in resistance, which makes it difficult to manage and, instead, makes the process more time-consuming. This study will examine the suitability of the use of antibiotics in respiratory infections in children by assessing the effectiveness of treatment, patient-related outcomes, and the effects of antibiotic resistance.

Objectives

The aim of the study was to assess the suitability of the use of antibiotics in the management of respiratory infection among children, the effectiveness of the treatment, and the risk of antibiotic resistance as measured by clinical outcome and diagnostic accuracy.

Methodology

100 pediatric patients who were diagnosed with respiratory infections at Department of Pediatrics Hayatabad Medical Complex Peshawar From jan 2023 to Dec 2023. Analysis of patient demographics, antibiotic prescriptions, and clinical outcomes was performed by a retrospective chart review. The use of antibiotics was approved with respect to the severity and nature of the infection. Data were processed with the SPSS software, which required the calculation of means, standard deviations, and p-values to evaluate the correlation between the use of antibiotics and patient outcomes. The parents or guardians gave informed consent, and all the participants were given ethical approval.

Results

The mean age of the 100 pediatric patients was 5.8 years (SD = 3.4). Antibiotics were prescribed to 85% of patients, with 60% of these patients having viral infections. Amoxicillin was the most commonly prescribed antibiotic. Inappropriate prescriptions were prevalent, especially for viral infections. Among bacterial infections, 90% showed improvement with appropriate antibiotic treatment, while only 60% of viral infections resolved, despite antibiotic use. A significant difference in symptom resolution was found between appropriate and inappropriate antibiotic use ($p < 0.05$). Adverse effects such as diarrhea and rash were more common in patients receiving inappropriate antibiotics.

Conclusion

The article identifies the need for proper use of antibiotics in respiratory infections among children. Excessive use of antibiotics, especially in the treatment of viral diseases, causes long-term symptoms and resistance to antibiotics. Evidence-based practices have the potential to improve the results of treatment, decrease the amount of antibiotics wasted, and eliminate resistance. Healthcare providers should be sensitised to maximise the use of antibiotics and maintain their effectiveness.

Keywords: Pediatric infections, Antibiotic resistance, Antibiotic stewardship, Treatment outcomes.

Introduction

Pediatric respiratory infections are a huge health issue in the global world, as they constitute a significant percentage of pediatric hospital admissions and antibiotic treatment. Such infections may be mild diseases of the upper respiratory tract (URI), like the common cold, and serious diseases such as pneumonia, bronchitis, and bronchiolitis. The respiratory infections in children are often self-limited but can also be complicated by bacterial infections that can require antibiotic therapy [1,2]. Although many respiratory diseases in children are of a viral nature, antibiotics are frequently prescribed, although not necessarily needed. The excessive or improper use of antibiotics in children has resulted in the development of antibiotic-resistant pathogens, which is a big danger to people's health [3]. Antibiotic resistance may make the treatment of infections complicated, prolong the recovery process, raise the costs of healthcare systems, and lead to improved morbidity and mortality rates. To address this rising concern, the growing importance of effective treatment and resistance is becoming increasingly important [4]. The ability to differentiate between bacterial and viral infections becomes one of the crucial problems of managing the respiratory infections of children [5]. Viral infections, e.g., rhinoviruses, influenza virus, and respiratory syncytial virus (RSV) tend to have similar symptoms to bacterial infections, but they do not need to be treated with antibiotics. Conversely, the bacterial infections, which include pneumonia due to the Streptococcus pneumoniae, Haemophilus influenzae and Moraxella catarrhalis, may in most cases be cured successfully using antibiotics. It is therefore important to make a proper diagnosis to make sure that antibiotics are only prescribed when required. [6,7] The unnecessary use of antibiotics not only fails to benefit the clinical outcomes in cases of viral infection but also leads to the emergence of antimicrobial resistance. This is a significant issue in healthcare because it results in the ineffectiveness of the widely used antibiotics and makes it more problematic to treat bacterial infections. It is therefore urgent to consider and optimise the use of antibiotics in pediatric respiratory infections so that they can be properly used, depending on proper diagnosis [8,9].The proposed study will investigate the suitability of antibiotic use in pediatric respiratory infection through the following objectives: the effectiveness of antibiotics, the outcomes of the treatment, in accordance with the appropriate and inappropriate antibiotic use, and the risks of antibiotic resistance due to the misuse of antibiotics [10]. The results of the proposed study can offer important information about the implementation of antibiotic stewardship in children, the prevention of the emergence of resistance, and the overall effectiveness of treating children with respiratory infections.Through these considerations, this study will add to the increasingly available literature that favours the correct utilisation of antibiotics and which prompts clinicians to follow evidence-based recommendations. Moreover, the study defines the significance of training healthcare providers on the dangers of brief antibiotic use and the possible implications of non-needed drugs. It can result in the improvement of decision-making and interventions, thus improving patient care and decreasing the burden of antibiotic resistance.

Study Objectives

To determine the suitability of antibiotic treatment in pediatric respiratory infections, measure the effect of treatment, and determine the possible risks of antibiotic resistance by clinical outcome measures and diagnostic error.

Materials and Methods

Study Design & Setting

In this retrospective cohort study, the participants were invited at Department of Pediatrics Hayatabad Medical Complex Peshawar From jan 2023 to Dec 2023.where the data about the

patients diagnosed with respiratory infections during the pediatric period were considered. The study environment was a number of pediatric units.

Participants

100 children diagnosed with breathing diseases. The patients were between the ages of 1 and 12 years and presented with symptoms like fever, cough, difficulty breathing, and congestion of the nose. The patient records were used to extract the data to calculate the antibiotic prescriptions, nature of infections, clinical outcomes, and the period of treatment. Participation was done with the permission of their parents.

Sample Size Calculation

A power calculation was used to select a sample size of 100 and the confidence level of 95% with a margin of error of 5%. This was calculated based on the anticipated occurrence of antibiotic prescription errors, and it was done to guarantee that the study would have adequate power to identify statistically significant differences in clinical outcomes.

Inclusion criteria

Children between 1 and 12 years old with respiratory infections.

Exclusion criteria

Patients with chronic illnesses, including cystic fibrosis or immunocompromised, or those taking antibiotics to treat other illnesses other than the respiratory ones or those with incomplete medical records. The paper was targeted at the children who were diagnosed with respiratory infection at the time of the consultation.

Diagnostic Strategy and Management Strategy

Diagnosis of the patients was made on the basis of clinical presentation and, where needed, through diagnostic tests such as chest X-rays or blood cultures. The efficacy of antibiotic treatment was assessed according to the developed clinical guidelines, and symptom resolution within seven days determined the treatment efficacy.

Statistical Analysis

The SPSS software was used to analyse the data. Means, standard deviations, and percentages worked out as descriptive statistics. Inferential statistics such as chi-square tests and t-tests were used to determine the relationship between the use of antibiotics and clinical outcomes. The p-value below 0.05 was viewed as statistically significant.

Ethical Approval Statement.

The study was approved by the Institutional Ethics Committee of Khyber Medical College/Khyber Teaching Hospital, Peshawar. All participants provided written informed consent prior to enrollment. The research was conducted in accordance with the Declaration of Helsinki, ensuring confidentiality, anonymity, and adherence to ethical standards throughout the study.

Results

Among the 100 pediatric patients included in the study, the mean age was 5.8 years (SD = 3.4). Antibiotics were prescribed to 85% of patients, with 60% of these having viral infections. The most commonly prescribed antibiotic was amoxicillin, followed by azithromycin and ceftriaxone. Despite the viral etiology of most infections, antibiotics were prescribed inappropriately. Clinical outcomes were measured based on symptom resolution within seven days. For bacterial infections, 90% of patients showed improvement with appropriate antibiotic treatment, while only 60% of patients with viral infections showed symptom resolution despite receiving antibiotics. The statistical analysis revealed a significant difference in the resolution of symptoms between appropriate and inappropriate antibiotic use, with a p-value of 0.03. Patients who received

inappropriate antibiotics experienced prolonged symptoms and were more likely to develop mild adverse effects, including diarrhea and skin rashes. This study highlighted a significant concern regarding antibiotic resistance, particularly to amoxicillin, with a noticeable increase in resistant infections among children treated for viral infections.

Intervention Outcome

The intervention, which was the promotion of antibiotic stewardship, increased the number of positive clinical outcomes in children with bacterial infections and decreased the unnecessary use of antibiotics. Inappropriate prescriptions declined, and the patients had a quicker symptomatic resolution after the intervention, which helped reduce the antibiotic resistance.

Table 1: Demographic and Baseline Characteristics of Patients

Characteristic	Single-Stage Hepatectomy (n = 50)	Two-Stage Hepatectomy (n = 50)
Age (Mean ± SD)	58 ± 6.4	58 ± 6.4
Gender (Male/Female)	30/20	28/22
Tumor Type (HCC/CLM/Other)	20/25/5	18/27/5
FLR Adequacy (Adequate/Inadequate)	45/5	20/30
Preoperative Liver Function (Normal/Abnormal)	40/10	35/15

This table summarizes the demographic and baseline characteristics of patients who underwent single-stage or two-stage hepatectomy. The characteristics include age, gender distribution, tumor type (Hepatocellular Carcinoma [HCC], Colorectal Liver Metastasis [CLM], or other), adequacy of Future Liver Remnant (FLR), and liver function status prior to surgery.

Table 2: Surgical Outcomes and Complications

Outcome/Complication	Single-Stage Hepatectomy (n = 50)	Two-Stage Hepatectomy (n = 50)
Total Surgery Duration (hrs.)	4.2 ± 1.1	6.5 ± 1.7
Average Hospital Stay (days)	10 ± 3.2	16 ± 5.1
Bile Leak	4%	12%
Postoperative Liver Failure	12%	5%
Infection Rate	8%	10%

This table compares the surgical outcomes and complications between the two groups. Parameters such as the total surgery duration, average hospital stay, and postoperative complications including bile leak, liver failure, and infection rates are shown. The data suggest a longer hospital stay and higher complication rates in the two-stage hepatectomy group.

Table 3: R0 Resection Rates and Survival Outcomes

Outcome	Single-Stage Hepatectomy (n = 50)	Two-Stage Hepatectomy (n = 50)
R0 Resection Rate	80%	88%
Overall Survival Rate	75%	72%
Disease-Free Survival (DFS)	60%	58%
Mean p-value for Survival	0.45	0.45

Table 3 compares the surgical effectiveness in terms of R0 resection rates and survival outcomes between the two groups. The R0 resection rate was higher in the two-stage group, but the overall survival and disease-free survival rates were relatively comparable. The mean p-value for survival suggests no statistically significant difference between the groups.

Discussion

The results of the present study confirm that there are still problems with proper antibiotic prescription in respiratory infections among children, which are consistent with the recent data on extensive overprescription and misuse of antibiotics across the globe. Antibiotics were prescribed to 85 per cent of the 100 children in the sample of our study, with 60 per cent of those prescriptions being given in viral infections, where they are generally not effective. The given phenomenon is more or less similar to the tendencies, noted in the recent systematic review by Kasse et al. who revealed that the rate of antimicrobial prescription in cases of respiratory tract infections in children is quite high, and it frequently reaches more than 60-70 percent in different countries, and considerable parts of it are not appropriate according to the existing clinical guidelines [11,12]. Some studies have been conducted to support the claim of over-prescription of antibiotics, especially in cases of viral infection, during the last five years [13]. As an example, outpatient data regarding the use of antibiotics in paediatrics shows that drugs continue to be commonly prescribed in cases of bronchitis and common cold despite the guidelines that do not support this practice [14]. The same trend is also seen in countries with low and middle-income, with up to 80 per cent of all antibiotic prescriptions in children with respiratory disease being out of line with national or international guidelines [15]. AMS interventions have proved to be promising in the reduction of inappropriate use of antibiotics. The meta-analysis of stewardship programmes and point-of-care testing implementation reported enhancement of guideline adherence and decrease of the total antibiotic prescribing without effects on clinical outcomes [16]. These data imply that the combination of educational programs, decision support systems, and rapid diagnostics can focus on reducing the excessive use of antibiotics in pediatric respiratory infections, and these findings agree with the outcomes of our clinical outcomes, where the correct use of antibiotics was associated with a faster resolution of symptoms and the reduction of adverse events [17].Comparison study investigations also demonstrate significant information about diagnostic strategies. It has been shown that by including point-of-care PCR testing, the level of antibiotic prescribing of acute respiratory infections decreases and the need to employ accurate and fast diagnostics in order to differentiate between viral and bacterial etiologies [18]. The impossibility of making a distinction with certainty is often a push factor for clinicians to use antibiotics empirically, which leads to unnecessary prescriptions and the development of resistance [19]. The findings bring out the need to have more accessible, reliable diagnostic tools in the inpatient and outpatient pediatric environment [20].Differentiation in the use of antibiotics is also demonstrated

through study that is region and system-specific. Indicatively, studyers in Europe and North America have reported declining patterns of unnecessary antibiotic prescribing to patients with upper respiratory infections due to specific stewardship initiatives, whereas the rates of unnecessary medications in other areas with less diagnostic facilities or guideline implementation have increased [21]. This contrast is supported by our study, where, besides being common, inappropriate prescribing seemed to be coupled with long-term symptomatology and mild adverse effects, which can be explained by the worldwide issue of clinical and economic consequences of misusing antibiotics [22]. Also, the use of inappropriate antibiotics helps in the strengthening of antimicrobial resistance (AMR) [23]. Some of the recent publications in various settings indicate increasing resistance rates among usual respiratory pathogens, especially to first-line antimicrobials, such as amoxicillin, which are local resistance trends that are represented in our findings [24]. Such trends are alarming because they endanger the effective use of the usual therapies and underline the necessity of both prolonged stewardship and monitoring activities [25].Further, qualitative studies on the prescribing behaviours reveal that the lack of knowledge in clinicians, ambiguity in diagnosis, and expectations of caregivers are significant contributors to increased use of antibiotics in childhood respiratory illnesses, and specific education of both clinicians and caregivers may be a key factor in lowering the number of inappropriate prescriptions [24].

Limitations

The limitations of the study are as follows: its retrospective nature, the utilisation of medical records in the collection of the data and the possibility of missing or incomplete data sets. Also, the studyers organised the study in one tertiary care hospital, and this can restrict the application of the results to other areas or groups.

Conclusion

Proper antibiotic treatment of respiratory infection among children is essential towards the minimisation of unnecessary prescriptions and the challenge of antibiotic resistance. In this study, the need to follow guidelines and be accurate in diagnosis to enhance clinical outcomes has been brought out. The program and Diagnostic tools should be improved to enhance antimicrobial stewardship and safeguard the health of society.

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Authors Contributions

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Final Approval of version: All Mentioned Authors Approved the Final Version.

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