Audit of Antibiotic Uses in Pediatric Intensive Care Unit of Assiut University Hospital

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Abstract

Background: Antimicrobial therapy is common among patients hospitalized in Intensive Care Units (ICUs) compared with patients in the general hospital population. Overuse and inappropriate use of antibiotics are key factors contributing to emergence of multidrug-resistant pathogens, so surveillance of their use is important.

Aim of Study: To assess the appropriateness of antimicrobial prescription according to clinical and microbiological findings, and formulary guidelines.

Patients and Methods: The study included 162 patients who stayed longer than 24 hours in the pediatric ICU.

Results: All of the total 162 patients admitted in PICU during the study period received antibiotics: Of them 30.8% (n=50) prophylactically, 70.3% (n=114) empirically, and 11.7% (n=19) therapeutically. 18.5% of patients received one antibiotic, and 81.5% received two or more antimicrobial combination.

Conclusion: This study provides valuable insight to antibiotics usage in PICU of developing country, which shows that antibiotics are prescribed universally in our PICU. Strategies to assess the need for antibiotic use are needed.

Key Words: Antibiotic use – infection – Pediatric Intensive Care Unit.

Introduction

ANTIMICROBIAL therapy is common among patients hospitalized in ICUs as they have more chronic comorbid illness and acute illnesses, injuries, and surgical procedures compared with patients in the general hospital population. In addition, patients in ICUs are often exposed to invasive devices or procedures that provide a portal of entry for microorganisms. Those patients are also susceptible to colonization and infection with nosocomial pathogens. At times these nosocomial pathogens may be antimicrobial-resistant organisms, and thus, may be difficult to treat [1,2].

Hospital Acquired Infections (HAIs) have been reported to affect 16-23.6% of patients admitted in PICUs [3-5]. Infections caused by antimicrobial-resistant bacteria are associated with higher mortality rates [6,7].

Subjects and Methods

A total number of 243 patients were admitted to PICU from 1 st April 2016 to 30 September 2016, 81 of them who stayed for less than 24 hours were excluded from the study.

Study site:

Pediatric ICU at Assiut University Children Hospital, Tertiary, Care Center.

Inclusion criteria:

- Infants and children from age of one month to 17 years old.

- Patients who stayed longer than 24 hours in the PICU.

Data collection:

Reviewing sheets and medical records of 162 patients who stayed longer than 24 hours in the PICU from 1 st April 2016 to 30 September 2016. Each admission was considered a patient encounter.

Data collected included demographic variables (age, gender), clinical, laboratory, and microbiological data. For each patient the cumulative number of antibiotics prescribed during the length of stay in PICU was recorded. The indications of antibiotics were categorized as prophylaxis, empirical, and therapeutics.

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Statistical analysis:

The data were entered and analyzed using statistics computer program. Unpaired *t*-tests were used to compare means and Chi square tests of proportion to compare categorical variables. A two-tailed *p<0.05* was considered statistically significant, and *p<0.01* was considered statistically highly significant.

Results

Demographic data of studied patients are described in (Table 1). The median age of our sample was 18 months. Mean length of stay in PICU was 7.25 days. The most common reasons for admission to the PICU was respiratory distress (55.5%).

Antibiotics surveillance data:

All patients (100%) admitted to our PICU received antibiotics, 30 (18.5%) received one antimicrobial agent, and 132 (81.5%) received two or more antimicrobial agents. Of them 114 patients received empirical antibiotics. 50 patients received prophylactic antibiotics. Only 19 patients received targeted antibiotics according to the result of culture and sensitivity. We could not determine the indication for 12 (3.14%) prescriptions (Table 2).

The 10 most commonly prescribed antimicrobial agents during the study period are listed in Fig. (1). Overall, Ampicillin/sulbactam, Ceftriaxone, and vancomycin were the three most commonly used antimicrobials, accounting for 56.3% of the total antimicrobial prescriptions during the study period.

Fig. (2) shows results of cultures obtained during period of the study. More than 80% of blood cultures obtained were positive. More than 70% of tracheal aspirate done during the study period were positive. Also about 80% of urine cultures obtained during the study period were positive. The single cerebrospinal fluid culture which had been done during the study period was negative, the same was for burn swab.

Fig. (3) shows the commonest isolated organisms from cultures of the studied group. Klebsiella pneumonia was the commonest organism isolated from cultures obtained during the study period, followed by Coagulase-negative staphylococci and Acinetobacter baumanni. The most common microorganisms isolated from tracheal aspirate cultures were Klebsiella pneumonia, Acinetobacter baumanni, and Pseudomonas aeruginosa. Coagulase-negative staphylococci were frequently isolated from blood cultures.

Six (33.3%) of 18 positive tracheal aspirate cultures were resistant to all antibiotics, compared to 2 (10%) of 20 positive blood cultures were resistant to all antibiotics (*p*=0.08).

Fig. (4) shows that 22.8% of the studied patients had hospital acquired infection, 16 patients had ventilation acquired pneumonia, 13 patients had nosocomial sepsis, and 8 patients had hospital acquired urinary tract infection.

Table (1): Demographic data of the studied group.

Variables	Characteristic	Total N=162
Gender	Male	81 (50%)
	Female	81 (50%)
Age	Median age in years (mean ± std)	1.5 (3.4±4.5)
Age categories	Infants (>1mo-12mo)	63 (38.9%)
	Toddlers (12mo-24mo)	28 (17.3%)
	Children (>2yrs-12yrs)	54 (33.3%)
	Adolescents (>12yrs)	17 (10.5%)
Weight	Median weight in kg (mean ± std)	10 (14.75±14.8)
Length of stay in PICU	Median length of stay in PICU in days (mean ± std)	5 (7.25±6.96)
Invasive devices	Endotracheal tube	123 (75.9%)
	Foley catheter	125 (77%)
	Central venous catheter	13 (8%)
Nutrition	Parenteral nutrition	102 (62.9%)
Reasons for admission	Respiratory distress	90 (55.5%)
	Disturbed conscious level	35 (21.6%)
	Peri-operative	11 (6.8%)
	Others	26 (16%)
Survival	Discharged from the PICU alive	65 (40.1%)

Abbreviations:
std : Standard Deviation.
kg : Kilograms.
PICU : Pediatric Intensive Care Unit.
mo : Month.
yrs : Years.

Table (2): Indications for antimicrobials therapy.

Indication	Number of patients (%) (n=162)	Number of Antimicrobial Prescriptions (%) (n=382)	Median treatment days (mean ± std)
Empiric	114 (70.3%)	263 (68.9%)	5 (5.5±4.0)
Prophylactic	50 (30.8%)	75 (19.6%)	4 (4.8±3.3)
Targeted	19 (11.7%)	32 (8.4%)	7 (9.3±8.1)
Unknown	12 (7.4%)	12 (3.1%)	2 (3.5±2.1)

Note:
*: Number of patients in each category is greater than 162 because some patients received antimicrobial agents for more than one indication.
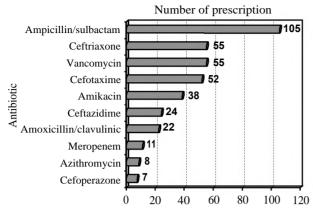*Abbreviations:*
std: Standard Deviation.

Fig. (1): The 10 most commonly prescribed antimicrobial agents in the study.
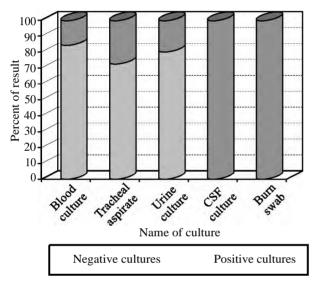

Fig. (2): Cultures done for patients in PICU and their results.
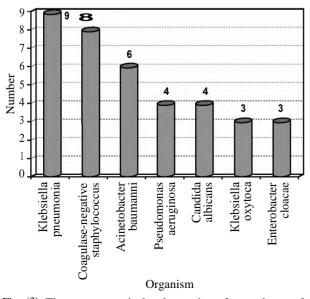
Abbreviation:
CSF: Cerebrospinal Fluid.

Fig. (3): The commonest isolated organisms from cultures of studied patients.
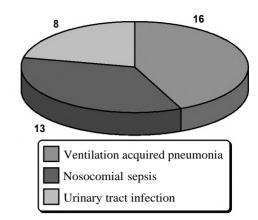

Fig. (4): Number of patients who had hospital acquired infection.

Discussion

Descriptive data on antimicrobial use is important because it would reveal the extent of use and temporal trends of antimicrobial use in a PICU.

Our study highlights some very important points. The entire patient population (100%) received antibiotics as prophylaxis or empirical therapy compared to other studies that reported antibiotic usage of 36- 100% in their PICUs [2, 8-10].

Blood cultures had been obtained from 24 patients during the study period. The majority (83.3%) of them were positive which is significantly higher than negative results (16.7%) (p<0 .0001). Qalab and colleagues reported that the blood cultures were positive in 14% [2].

Tracheal aspirates had been obtained from 25 patients during the study period, 18 (72%) of these tracheal aspirates were positive which is significantly higher than negative results (28%) (p= 0.002). Qalab and colleagues reported that the tracheal aspirates were positive in 24% [2].

Six (33 .3%) of 18 positive tracheal aspirate cultures showed multi-drug resistant bacteria to all available antibiotics, compared to 2 (10%) of 20 positive blood cultures were resistant to all antibiotics (p=0.08).

Multi-drug resistant pseudomonas aeruginosa was isolated in five positive cultures, where multi-drug resistant Klebsiella species was isolated in four positive cultures.

Our study shows that empirical therapy was prescribed to the majority (70.3%) of the patients. This might have been due to the reason of limited microbiologic yield and the critical condition of the patients admitted to PICU. A similar study of

antibiotic use in PICU of Canada showed 27-40% usage of empiric antibiotic treatment [9] while another study by Ding et al., from China showed that 72% of their patients in PICU received empiric antibiotic treatment [8]. Qalab reported that 42% of patients in PICU received empiric antibiotic treatment [2].

In the present study misuse of antibiotics was observed in 12 patients (7.4%) without definite indication for antibiotics. Josiah reported that 8 patients (6%) received 18 antimicrobial prescriptions while they were not indicated for antibiotic use [11].

The most three common antimicrobial combinations used for empiric treatment were vancomycin and Ceftriaxone; Ampicillin/sulbactam, and Amikacin; and Ampicillin/sulbactam, and Cefotaxime, which is consistent with the unit's treatment protocols for treating sick patients.

Grohskopf and colleagues reported that cefazolin, vancomycin, and cefotaxime were the antimicrobial agents most frequently prescribed in their PICU [12]. Josiah also reported that vancomycin, gentamicin, and cefazolin were the antimicrobial agents prescribed most frequently [11]. Qalab and colleagues reported that cefazolin, meropenem, vancomycin, and ceftriaxone were the antimicrobial agents most frequently prescribed in their PICU [2].

Several studies have evaluated the prevalence and incidence of infections among children in Pediatric Intensive Care Units (PICUs). In a study done In Europe, incidence of Hospital Acquired Infections (HAIs) was 23.6% in Pediatric ICUs (PICU) [5]. In our study, 37 patients (22.8%) of 162 patients who were admitted to PICU during the study period had hospital acquired infection, 16 patients had ventilation acquired pneumonia, 13 patients had nosocomial sepsis, and 8 patients had hospital acquired urinary tract infection.

Conclusion:

This study provides valuable insight to antibiotics usage in PICU of a developing country. Our results points that overuse of antibiotics exists in our PICU. There is the need for microbiological support for clinicians to increase the rate of appropriate prescription and discontinue empirical therapy as soon as possible. Increasing the number of pediatric infectious disease specialists, practical antimicrobial treatment guidelines, and continuing education for residents are also important to resolve the problem of inappropriate antimicrobial use.

Recommendations:

Effective antimicrobial stewardship strategies that are easy to implement are needed. In addition, clinicians would benefit from a tool that helps them discriminate bacterial infections from non-bacterial infections and from systemic inflammatory response syndrome.

Residents and the fellows should be asked to complete an antimicrobial assessment form (AA) to document their rationale for starting antimicrobial therapy. This might remind pediatric intensivists to review antimicrobial therapies, especially empiric therapies, when the microbiologic data became available, thus, reducing the duration of antimicrobial therapy and possibly reducing the quantity (measured in grams) of antimicrobial consumpt.

Introduction of Infection preventionists and hospital epidemiologists will monitor and prevent healthcare-associated infections. They can also assist with monitoring and reporting of resistance, educating staff on the importance of appropriate antibiotic use, and implementing strategies to optimize the use of antibiotics.

Cultures must be performed before starting antibiotics with the help of well educated nurses. There is the need for microbiological support for clinicians to increase the rate of appropriate prescription and discontinue empirical therapy as soon as possible.

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مراجعة دواعى إستخدام المضادات الحيوية بوحدة العناية المركزة لمستشفى الأطفال الجامعى بآسيوط

آفادت العديد من الدراسات إرتفاع نسب إستخدام المضادات الحيوية بالمستشفيات، وخاصة مرضى العناية المركزة، ويرجع ذلك إلى أن حالة أغلب مرضى العناية المركزة حرجة مقارنة بمرضى الأقسام الأخرى، وأيضا مرضى العناية المركزة أكثر عرضة للتدخلات العلاجية والجراحية التى قد تكون مدخلا لكثير من الميكروبات المسببة للأمراض، بالإضافة إلى أن مناعة الأطفال بالعناية المركزة قد تكون أضعف من غيرهم مما يجعلهم أكثر عرضة لعدوى المستشفيات، والعدوى المقاومة للمضادات الحيوية.

إن الهدف من إجراء تلك الرسالة هو إعطاء صورة واضحة عن إستخدام المضادات الحيوية بالعناية المركزة ودواعى إستخدامها، وعما إذا كان هناك سوء إستخدام لتلك الآدوية أم لا.

لقد تمت مراجعة الملفات الطبية الخاصة بجميع الأطفال الذين مكثوا بالعناية المركزة أكثر من أربع وعشرين ساعة، وعددهم مائة وإثنان وستون طفلا، فى الفترة الزمنية من أول شهر أبريل عام ٢٠١٦ وحتى نهاية شهر سبتمبر ٢٠١٦، ويتراوح أعمارهم ما بين شهر وسبعة عشر عاما.

ومن نتائج هذه الدراسة: فقد وجد أنه تم إستخدام المضادات الحيوية مع جميع مرضى العناية المركزة بمستشفى الأطفال الجامعى بآسيوط، فى حين أنه لم يكن هناك داع لإستخدام المضادات الحيوية لعدد من هؤلاء المرضى. وعلى الرغم من أن جميع المرضى حصلوا على مضادات حيوية لأسباب عديدة، إلا أنه لم يتم عمل مزارع دم، ومسحة من القصبة الهوائية، ومزارع بول، إلا لعدد قليل منهم.

ومن أهم نتائج هذه الدراسة: وجود عدد ليس بقليل من مزارع الدم والمسحة من القصبة الهوائية تبين ميكروبات مقاومة لجميع أنواع المضادات الحيوية المتوفرة مما يؤدى إلى صعوبة علاج هؤلاء المرضى.

هناك أيضا نسبة من مرضى العناية المركزة قد أصابهم عدوى المستشفيات، وأثر ذلك سلبيا على المرضى، مما يستدعى ضرورة الإهتمام بوحدة مكافحة عدوى المستشفيات للحد من تلك العدوى.

نستنتج من النتائج الموضحة فى هذه الدراسة أننا بحاجة إلى وضع بروتوكول لإستخدام المضادات الحيوية حسب حالة المريض، ونتائج التحاليل المتوفرة، ولابد من نشر الوعى بين الأطباء فيما يخص المضادات الحيوية وضرورة تجنب الإستخدام الخاطئ لها فى حدود عدم الإضرار بمصلحة المريض.