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Antibiotics prescription pattern and resistance profile of common isolates at Soba university hospital in Khartoum, Sudan, a retrospective cross sectional study

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ABSTRACT

Introduction: Antimicrobial resistance (AMR) is an increasingly global public health threat. An average of 45% of all patients are prescribed antibiotics. Nearly 50% of these prescribed antibiotics are unnecessary and they may promote the emergence of resistant strains. Antimicrobial stewardship programs have been introduced to tackle this problem. In this study we aim to determine the pattern of antibiotics prescription and resistance profile of common bacterial isolates at Soba university hospital, Sudan.

Methods: A retrospective cross sectional study that was conducted at the medicine and surgery wards in a tertiary care hospital. Records of all patients who were admitted during the study period were included. A pretested data collection form was used to collect information.

Results: Records of 269 inpatients were reviewed. The mean age of patients was 49.5 ± 18.7 years. The most frequently reported diagnoses on admission included cerebrovascular accident and chronic liver disease, with 10.6% and 7.1%, respectively. The mean duration of stay at the hospital was 6.6 ± 6 days. Almost 81.8% of admitted patients received antibiotics. The majority (38.7% and 34.2%) were given one, and two antibiotics, respectively. Most of the antibiotics were administered intravenously (82.1%). Third generation cephalosporin antibiotics (38%) and metronidazole (21.7%) were the most frequently prescribed. No documented indication for antibiotic prescription was found in 40.5% of cases. The main reason for stopping antibiotics was the patients' discharge (63.6%). Of patients receiving antibiotics, only 5 (1.9%) had undergone culture. Complete blood count (CBC) was requested in nearly all patients (99.2%). A total of 100 cultures were performed during the study time. Most of them were urine cultures (64%). *Escherichia coli* was isolated from 14 (29.2%) cultures. Resistance percentage was highest for erythromycin, and oxacillin (100% for both).

Conclusion: The study shows a trend of antibiotic misuse. Most patients received antibiotics without documented indication. Antibiotics sensitivity results showed high levels of resistance among isolated organisms. We recommend a wider study and formulation and implementation of clear guidelines to regulate antibiotic use.

Keywords: Antibiotic, Hospital, Prescribing pattern, AMR, Sudan

Introduction

Antimicrobial resistance (AMR) is an increasingly global public health threat, that in the 21st century, the possibility of a post-antibiotic era in which common infectious diseases can kill is very tangible (1). Antimicrobial resistance has been linked directly via epidemiological studies to the consumption of antibiotics; misuse and overuse of these medicines is a substantial contributor to the antibiotic resistance (2–5). Over prescription of antibiotics results in applying a polarized, strong selective stress leading to the displacement of sensitive species and the rise of resistance ones (6,7).

It is estimated that more than half of the world's medicines are sold, dispensed, or prescribed inappropriately (8). Additionally, reports indicated that two-thirds of antibiotic dispensing globally occur without prescription, and an average of 45% of all patients are prescribed antibiotics; this figure might rise up to over 70% of patients in some countries (9). Moreover, nearly 50% of these prescribed antibiotics are unnecessary and they may promote the emergence of resistant strains (10,11). The magnitude of this issue increases in developing countries due to many factors including: underdeveloped health systems, unregulated over the counter sale of antibiotics, inappropriate use and poor prescription practices, and increased rates of antimicrobial resistance (12–14).

To tackle this issue, interventions have been introduced in order to optimize usage of antimicrobials, and encourage appropriate prescription practices, which are known collectively as antimicrobial stewardship programs (15). The goal of these interventions is a cost-effective usage of antimicrobials, while maximizing their therapeutic effects and decreasing their drug related toxicity and antimicrobial resistance (16).

Although the majority of antibiotic usage is within the community; increased antibiotic usage per patient, resistant pathogens, and infections due to resistant organisms are all concentrated more within hospital-settings (17,18) Studies showed that antibiotic stewardship interventions in hospitals help to increase compliance with the local guidelines of prescriptions, and the clinical outcomes for patients (19–21). However, before organizing and implementing an antimicrobial stewardship program, information about prescription patterns and the situation of antimicrobial resistance need to be acquired (22).

In this study we aim to determine the pattern of antibiotics prescription and resistance profile of common bacterial isolates at Soba university hospital, Sudan.

Methodology

Study setting and participants

The is a retrospective cross sectional study that was conducted in Soba university teaching hospital, Khartoum, Sudan, which is a tertiary care hospital and the main teaching hospital for faculty of medicine, university of Khartoum. It consists of four major departments (internal medicine, surgery, pediatrics and obstetrics and gynecology). Total coverage of all patients who were admitted to the general medicine or surgery units at Soba university teaching hospital during August and September 2018 were included in the study.

Data acquisition and analysis

Data was collected from medical and laboratory records using well designed data collection sheets based on previous similar studies and it was pretested. Data sheets inquired about information regarding patients' sociodemographic characteristics, admission and hospital stay, antibiotics prescribed, and tests ordered. In addition, information regarding antibiotic sensitivity and culture results were also obtained retrospectively. Data was entered and analysed using statistical package for social sciences (SPSS) version 21.0. Descriptive statistics were conducted. Categorical data was described by frequencies and percentages, while continuous data was described using means and standard deviations (SD).

Ethical consideration

Ethical approval was obtained from the Soba Centre for Audit and Research, general director of soba university hospital, the statistic department and the head of laboratory unit at the hospital.

Results

The audit included the records of 269 patients, which was nearly halved between males (50.2%), and females (49.8%). The mean age of patients was 49.5 with a standard deviation (SD) of 18.7. Majority of patients were admitted to the internal medicine department (65.1%), and nearly all of them (96.7%) were admitted to the wards, with only 1.1%, and 2.2% being admitted to the intensive care unit (ICU), and high dependency care unit (HDU), respectively.

The most frequently reported diagnoses on admission included cerebrovascular accident, chronic liver disease, malaria, and cholecystitis with 10.6%, 7.1%, 6%, and 4.3%, respectively. Duration of stay in the hospital ranged from 1 to 43 days, with a mean of 6.6 (SD =6).

Out of 269 patients admitted during the study period, 220 (81.8%) received antibiotic prescription during their stay. Number of antibiotics prescribed for each patient ranged from 1 to 7 antibiotics, with the majority (38.7%, and 34.2%) given one, and two antibiotics, respectively. The total number of antibiotics prescribed amounted 350, most of which (82.1%) were administered intravenously, with only 16.8%, and 1.1% being oral, and intramuscular, respectively. Third generation cephalosporin antibiotics were the most frequently prescribed with 133 prescriptions (38%), followed by metronidazole 76 (21.7%), and second generation cephalosporin antibiotics 70 (20%). The mean duration of antibiotic administration was 4.5 days (SD =3.5), ranging from 1 to 20 days. Table 1 illustrates details of antibiotics prescribed.

Regarding indication of antibiotic prescription, over one third of patients who were prescribed antibiotics (40.5%) did not have any documented indication, while prophylaxis, sepsis, urinary tract infection, and pneumonia were the most frequently documented indications, with 29.3%, 10.3%, 6%, and 5.6%, respectively. Of the patients who were prescribed antibiotics, only 4 patients (1.8%) developed complications related to the antibiotic's administration. The main reason for stopping antibiotics was the patients' discharge (63.6%). Table 2 shows details of indications of antibiotic prescription.

Out of 224 patients who were prescribed antibiotics, only 5 (1.9%) had undergone culture, and in all of them, culture sample was taken after starting the antibiotic. In addition, culture results were positive, and led to a change in the antibiotic prescribed in 4 patients. *Klebsiella* organism was isolated from 2 patients, while staph aureus, and methicillin resistant staphylococcus aureus (MRSA) were each isolated from 1 patient. Regarding other investigations, complete blood count (CBC) was requested in nearly all of patients (99.2%), followed by renal function tests (RFT) (93.1%), urinalysis (59%), and liver function tests in 38.7% of patients. Table 3 details information of requested investigations.

We analyzed blood and urine culture results undertaken for patients in internal medicine, and surgery departments during the period of the study. A total of 100 cultures were performed, most of the them (86%) from the internal medicine department, and majority of them (64%) were urine cultures. About half of the cultures (49%) were negative, and out of 51 positive cultures, 44 (86.3%) isolated one organism, while 7 (13.7%) isolated two organisms.

Total number of bacterial isolates was 48, while candida species was isolated in 9 cultures. Among bacterial isolates, *Escherichia coli* was isolated from 14 (29.2%) cultures, *Klebsiella pneumoniae* from 10 (20.8%), *Enterococcus faecalis* from 9 (18.8%), and *Pseudomonas aeruginosa* from 7 (14.6%). Two isolated organisms (*Coccobacilli*, and *Klebsiella* species) were resistant to all tested antibiotics. Resistance percentage was highest with erythromycin, and oxacillin (100% for both), followed by cephalexin (92.6%), cefuroxime (85.7%), ceftriaxone (82.6%), and tetracycline (80%), while it was lowest with meropenem (12.5%), vancomycin (14.3%), amikacin (20.8%), nitrofurantoin (24.1%), and imipenem (25%). Table 4 shows details of isolated strains and resistance.

Discussion

Antibiotic resistance is considered to be a warning global public health problem, as a result of inappropriate prescription, and misuse of antibiotics. In this study, our main objective was to determine the pattern of antibiotic prescription resistance profile of common bacterial isolates at Soba university hospital, Sudan.

In our study, 81.8% of patients received antibiotics during their admission, which is consider to be high in comparison with other studies in Nigeria, Canada, Ethiopia, Oman, and local studies in Elobeid, southern Sudan, and Khartoum, central Sudan which have reported prescription rates of 69.7%, 31%, 58.1%, 64%, 58.5%, and 65%, respectively. (22–27)

Additionally, 82.1% of these prescribed antibiotics were administered intravenously, which is higher than what was reported in other different studies (28–30). This high prevalence is alarming as parenteral antibiotics are costly, and the cost of medications is a major factor that may affect compliance to treatment in resource-limited countries (22,26,28). Moreover, usage of parenteral routes requires more advanced level of training for health personnel, and it can increase the risk of transmission of infectious diseases (24).

Third generation cephalosporins and metronidazole were the most commonly prescribed antibiotics with an average of 38%, and 21.7% respectively. This corresponds with findings of two similar studies in Nigeria, and another one in Elobied, southern Sudan in which third generation cephalosporins were the most commonly prescribed with an average of 34.5% (22,26,28) while a study from Oman reported that prescription of piperacillin/tazobactam, amoxicillin/clavulanic acid and clarithromycin predominated (25).

Over one third of patients in our study (40.5%) lacked an indication for antibiotic prescription, which is considered another form of poor-prescribing practice (28). Also, there was poor documentation of the requested microbiological investigations as the patient's records showed that only 5 (1.9%) patients had undergone culture, while the hospital laboratory reports in the same study period reported that there were 100 culture requests received from general medicine and surgery wards. In spite of this, the use of broad-spectrum antibiotics particularly cephalosporins predominates in this study, and this may be due to lack of diagnostic tools or poor utilization of available ones (22).

Of all patients to whom antibiotics were prescribed, cultures were conducted in only 5 (1.9%). Compared to other studies from different countries, this percentage was considered the lowest; a study conducted in India reported that cultures were performed to only 11% of the patients who were given antibiotics; another study from India also stated that cultures were done to only 19% of patients (31,32). Another study from Oman stated that only 25% of patients had undergone cultures before antibiotic administration (25). Moreover, a study from a tertiary referral center in Nigeria asserted that only 20% of their patients had undergone cultures before giving them antibiotics (28). In addition to low percentage of cultures, all the patients were already on antibiotics when their culture samples were taken, which might have altered the results of the cultures. Additionally, cultures were positive and led to a change in the prescribed antibiotic in 4 patients (1.5%), compared to 12% in Oman (25). This reinforces that the ability of a hospital to perform cultures and sensitivity tests, is linked with its ability to implement rational antibiotic therapy (33).

The trends of antibiotic resistance were obtained from analysis of cultures results from the departments of internal medicine and surgery. A total of 100 cultures were performed, of them 48 were positive for bacterial isolates; the most commonly isolated organisms were *Escherichia coli*, *Klebsiella pneumoniae*, *Enterococcus faecalis*, and *Pseudomonas aeruginosa*. *E. coli* isolates showed high levels of resistance ranging from (79-93%) to various antibiotics including third generations cephalosporins. This finding complements the results of a study conducted in a Sudanese hospital surgical wards in which the level of resistance was approximately 90% (34). Similarly, another study performed in Khartoum state hospitals reported that 92% of *E. coli*

isolates were MDR, and 53.3% were resistant to more than 7 antimicrobial agents (35). Also, a study conducted to test the sensitivity of agents causing UTIs to the commonly used antibiotics in a Sudanese hospital revealed that *E. coli* isolates were 65% resistant to the 14 utilized antibiotics (36). Comparably, studies from other countries also reported high levels of resistance of *E. coli* isolates (25,28,32). This high level of *E. coli* resistance in hospitals has many contributing factors including: lack of antimicrobial stewardships and strong infection control programs, and the easily available broad-spectrum antibiotics in the hospitals (37). Cultures were also positive for MRSA in this study, which is analogous to what has been discovered in a study performed in a Sudanese GIT surgery hospital, in which 71.4% of *Staphylococcus aureus* isolated were found to be MRSA (38).

Conclusion

This study revealed that most patients admitted to the medicine and surgery units during the study period have received antibiotics; majority of patients received more than one antibiotic, and most of them were administered parenterally. Additionally, third generation cephalosporin antibiotics were most commonly prescribed, and more than one-third of prescribed antibiotics were prescribed without documented indication. Furthermore, 100 cultures were performed during the study period; the most commonly isolated organisms were *Escherichia coli* and *Klebsiella pneumoniae*. Antibiotics sensitivity results showed high levels of resistance among isolated organisms, two of them (*Coccobacilli*, and *Klebsiella* species) were resistant to all tested antibiotics.

Recommendation

A larger multi-central study involving more departments and covering wider time period needs to be done. Antibiotic use audits should be a routine practice to ensure optimum antibiotic prescription practice. Clear guidelines should be formulated and implemented to prevent misuse of antibiotics and avoid resistance.

List of abbreviations

AMR: Antimicrobial resistance.

CBC: Complete blood count.

GIT: Gastrointestinal tract.

HDU: High dependency unit.

ICU: Intensive care unit.

MDR: Multidrug resistance.

MRSA: Methicillin resistance *staphylococcus aureus*.

RFT: Renal function test.

SD: Standard deviation.

SPSS: Statistical package of social sciences.

UTIs: Urinary tract infections.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Soba Centre for Audit and research, general director of soba university hospital and the statistic department at the hospital.

Consent for publication

All authors are informed of and consent to submission of this manuscript.

Availability of data and material

The dataset collected and analyzed in the making of this manuscript is available from the corresponding author on demand.

Competing interests

All authors declare that they have no competing interests.

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Authors' contributions

Formulation of the idea and study design: IA, FA, OA, AK, MA; manuscript drafting: IA, OA, FA, AK, AA; data collection: OA, FA, AK, MA, SA, HM, RE; data analysis and interpretation: AK; manuscript writing: FA, AK, AA.

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