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Abstract

Background: Prophylactic use of antibiotics before surgery is evidence-based practice for prevention of surgical site infections (SSIs).

Aims: To investigate adherence to and surgeons' perception of antibiotic prophylaxis guidelines.

Methods: A two-phase, cross-sectional prospective study conducted in two teaching hospitals. Phase 1: 6-month audit of prescriptions to investigate adherence rate to evidence-based guidelines. The important information was collected from medical charts through a predesigned proforma. Phase 2: self-administration questionnaire was used to investigate the surgeons' perception. Descriptive statistics, independent-sample Kruskal–Wallis test and multivariate linear regression analysis were performed using SPSS version 21.0.

Results: A total of 866 eligible surgical cases (acute appendectomy; n = 418; 48.2%), laparoscopic cholecystectomy (n = 278; 32.1%) and inguinal hernia (n = 170; 19.7%) were investigated. Surgical antibiotic prophylaxis was prescribed in 97.5% of procedures. Out of these, 9.5% adhered to guidelines with respect to correct choice, 40% for timing, and 100% for dose and route (optimal value 100%). Most patients received ceftriaxone (n = 503; 59.5%) as prophylactic antibiotic. The questionnaire (good internal consistency; $\alpha \geq 0.7$) was filled out by 200 surgeons. More than half (69%) of participants thought that antibiotics were overused. Most surgeons perceive that poor adherence to treatment guidelines is due to poor awareness, underestimation of infection, lack of consensus, and disagreement with guidelines recommendations.

Conclusions: Surgeons have positive perception that antibiotics should be used according to guidelines recommendations. However, we found poor treatment adherence to antibiotic prophylaxis guidelines.

Keywords: abdominal surgery, adherence, antibiotic prophylaxis, surgeons' perception, treatment guidelines

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Introduction

Globally, every year > 200 million individuals undergo surgical procedures (1). About 70% of the world's population belongs to low- and middle-income countries, and most of them have surgery-associated disorders (2). Postoperative infections are a major public health concern and account for ~7 million complications around the world (2,3). The most common cause of hospital-acquired infections in surgical patients is surgical site infections (SSIs), and surgical antibiotic prophylaxis (SAP) is used as standard practice to combat SSIs (4).

Per capita consumption of antibiotics is generally higher in high-income countries, but the greatest increase in antibiotic use between 2000 and 2010 was in low-income countries, where use continues to rise, and often, heavy use of antibiotics substitutes for infection control (3). It is reported that antibiotics constitute one third of all drugs used in hospitals and 80% of antibiotics are used in surgery-associated cases (5). Appropriate use of antibiotics provides optimal benefits, when administered for an appropriate indication, with correct choice, dose, time and duration (4,6,7). The antibiotic stewardship programme focuses on the appropriate use of antibiotics. Prevention of misuse, fighting against resistance, and promotion of appropriate use of antibiotics are the main goals of the stewardship programme (8). Various approaches being tried to tackle this health threat, such as understanding the factors that influence prescribing behaviour. Behaviour changes during prescribing are effective (8,9).

Despite the availability of guidelines, compliance rates with appropriate selection, timing, duration and use of antibiotics in surgical procedures are low among surgeons (6,10). Such practices in the healthcare system ultimately lead to increases in adverse events, antibiotic resistance, and costs of treatment (4,6,7). Due to the increased use of antibiotics in surgical procedures, it is necessary to address the compliance of SAP with evidence-based guidelines and investigate the perceptions of surgeons about determinants of antibiotic use.

The main objectives of this study were to compare current antibiotic prophylaxis practices with international standard treatment guidelines and evaluate the perception of surgeons in 2 tertiary care teaching hospitals in Islamabad, Pakistan.

Methods

Phase 1: observational study phase

Study design and settings

A 6-month prospective, observational, medical record-based study from January 1, 2017 to June 30, 2017 was conducted to investigate adherence of SAP practices with treatment guidelines. The study was conducted in national referral hospitals with 600 beds, providing medical facilities to Islamabad, Khyber Pakhtunkhwa, Azad Jammu and Kashmir, and Punjab.

Sample size, sampling technique and patient characteristics

According to the National Population Census 2017, the population of Pakistan was 207 776 954 and that of Islamabad 2 001 579 (https://www.citypopulation.de/php/pakistan-admin.php?adm1id=5). The minimum obligatory sample size calculated was 601 based on 95% confidence interval and 4% margin of error using the formula [n = N x/((N — 1) E2 + x)]; where N is the population size and E the margin of error. Rao soft sample size calculator was used to estimate sample size (http://www.raosoft.com/samplesize.html).

We aimed to highlight current prescribing practice; therefore, the minimum required sample size was calculated according to the World Health Organization (WHO)/International Network of Rational Use of Drugs methodology, which states a sample size of at least 600 encounters/prescriptions of patients are required to conduct a cross-sectional prospective study describing current treatment practice (11). Rather than specifying the number of patients, a time period was selected and all the patients who underwent 1 of 3 types of surgery in that period were enrolled according to the inclusion and exclusion criteria. A universal random sampling technique was used and patients who underwent 1 of the 3 most commonly performed abdominal surgical procedures (appendectomy, laparoscopic cholecystectomy and inguinal hernia repair) were assessed during the study period. Inpatients who met the inclusion criteria during the study period were invited to participate. After explaining the purpose and nature of the study, patients gave verbal and written consent to participate. The inclusion criteria were as follows: patients who underwent the selected abdominal surgeries; age > 16 years; and no previous infection or surgery. We excluded patients who did not give their consent and those undergoing palliative care.

Data collection tool

Medical records of selected patients were obtained and the desired information was collected on a predesigned standardized data collection form (Additional File 2). The type of surgery, details of antibiotic prophylaxis (antibiotic agents, administration route, dosage, time), and length of hospital stay were recorded.

Appropriateness and adherence to prescription guidelines

SAP was judged as appropriate if the antibiotic, dose, route and timing were in accordance with the recommendations of international guidelines (4,12). These guidelines emphasize the following aspects: (1) use of inexpensive narrow-spectrum antibiotics; (2) intravenous single dose prophylaxis; (3) administration of SAP within 1 hour before the first incision; (4) cefazolin as the first drug of choice; however, if there is allergy to beta-lactams then vancomycin or clindamycin are appropriate alternatives (metronidazole should be added against anaerobic

bacteria); and (6) dose of SAP. A prescription was confirmed to be adherent to guidelines if SAP was administered as per the guidelines. All the prescriptions were evaluated against each aforementioned recommendation and adherence rate for each recommendation, that is, indication, choice, timing, route and dose, was calculated by dividing the adherent cases by total cases. A simplified scheme for reviewing the prescription of SAP to investigate adherence to the guidelines is presented in Figure 1 .

WHO Anatomical Therapeutic Classification was also used to report antibiotic utilization (13).

Phase 2: Questionnaire-based study

Study design, and study population

After completion of Phase 1, a 2-month prospective questionnaire-based survey was carried out to assess surgeons' perception regarding antibiotic use, guidelines adherence and other factors related to antibiotic practices. Surgeons working at the selected hospitals were recruited on a daily basis, using a simple random sampling technique, on their ward rounds by the principal investigator from July 1 to August 30, 2017. A participant information leaflet was provided to all surgeons before the study.

Data collection tool

Investigators systematically and thoroughly reviewed the available literature (8,14) for development of a self-administered questionnaire (Additional File 2). The questionnaire was modified through content and face validity. The content was further validated by 2 academic experts. For modification, feasibility, and adjustment, the questionnaire was administered to a small group of 20 prescribers (10 from each hospital). After that, the recommended modifications were included in the questionnaire.

Reliability coefficients and internal consistency were measured by Cronbach's α in SPSS version 21.0. Cronbach's α was set at 0.76. The questionnaire was divided into 2 main sections: the first included questions regarding demographic characteristics, and the second was divided into three subsections: (a) included questions regarding antibiotic use in surgical procedures; (b) included items regarding guideline adherence; and (c) included questions about the hospital pharmacist's role. The responses were recorded on a 14-item Likert scale. Each item was scored separately as 1 (strongly disagree) to 5 (strongly agree); thus, total score ranged from 14 to 70, with higher scores indicating more positive perception.

Statistical analysis

Descriptive statistics were calculated as frequency and percentages for categorical variables and mean and standard deviation for numerical variables. Likert scale response often provides non-normally distributed data; therefore ,independent-sample Kruskal–Wallis tests were performed to find difference in surgeons' response to each item in the questionnaire according to demographic characteristics. Multivariate linear regression analysis was performed to find factors that affected surgeons' overall perception of antibiotic guideline adherence. $P \leq 0.05$ was defined as statistically significant. Statistical analysis was performed using SPSS version 22.0.

Ethical approval

The study was carried out in accordance with Declaration of Helsinki and approved by the Institutional Review Boards and Ethics Committees of Hospital A (Pakistan Institute of Medical Sciences, Islamabad, Pakistan: No. F.1-1/2015/ERB/SZABMU/), Hospital B (Shifa international hospital Islamabad, Pakistan: No. IRB-637-085-2016) and the Bioethical Committee of the Quaid-i-Azam University, Islamabad, Pakistan: No. DFBS/2016-623) (Additional File 3).

Results

Phase 1

Pattern of surgical procedures

A total of 1015 patients underwent common abdominal surgery. Among these, 149 (14.7%) were excluded due to incomplete medical records (n = 62), having previous surgery (n = 34) and age

SAP practice according to guidelines

SAP was prescribed in 845 (97.5%) surgical procedures (Table 1). However, appropriate antibiotics according to evidence-based guidelines were given to only 80 (9.5%) patients. Seven hundred and sixty-five (90.5%) patients received the wrong antibiotics with respect to guidelines, and they were not included in the calculation of the correct dose. Of the 80 patients to whom the correct antibiotic was administered, the right dose was administered in all cases. The route of administration was correct and according to recommendations. The timing of SAP was according to guidelines in 40% of patients (within 1 hour before surgical incision).

Pattern of antibiotics prescribed as SAP

Details of prescribed SAP are listed in Table 2 . The most commonly prescribed class of antibiotics was cephalosporins. In the case of individual antibiotics, ceftriaxone was the most frequently prescribed, to 503 (59.5%) patients.

Phase 2

Demographic characteristics of surgeons

There were more male (n = 110; 55%) than female (n = 90; 45%) prescribers. There were more respondents aged 30 years (n=29; 14.5%). Level of education was associate degree (n = 93; 46.5%), bachelor's degree (n = 80; 40%) and postgraduate degree (n = 27; 13.5%). The highest proportion of respondents had 20 years (n = 4; 2%).

Surgeons' perception of antibiotic guideline adherence

Strongly positive perceptions regarding many factors were demonstrated by all participants (Table 3
). Most surgeons agreed that antibiotics are overused in surgical procedures. A total of 194 (97%) surgeons agreed that they preferred broader-spectrum antibiotics instead of low spectrum antibiotics in a surgical procedure. One hundred and eighteen (59%) surgeons agreed that low availability of antibiotics in the hospital pharmacy affected the choice of antibiotics according to guidelines.

One hundred and twenty-eight (64%) surgeons agreed that evidence-based guidelines should be followed before prescribing antibiotics in surgery; 186 (93%) agreed that prescribing antibiotics without evidence-based guidelines is responsible for a high financial burden on patients; 135 (67.5%) agreed that lack of consensus by surgeons about the recommendation in the guidelines is a factor for inappropriate use of antibiotics; and nonavailability of consensus local hospital guidelines was reported by 193 (96.5%). A total of 194 (97%) surgeons agreed about the important and crucial role of the hospital pharmacist in the development of evidence-based guidelines.

The significant relationship between sex, age, final academic degree, experience and hospital setting and all items in the questionnaire was invetigated through independent-sample Kruskal–Wallis tests analysis. Many factors were statistically significant (P Table 4). Age, final academic degree, hospital settings and work experience were independent predictors (P

On comparison of findings of the 2 phases of the study (Tables 2 and 3), there was a difference between perception and prescribing behaviour of surgeons toward evidence-based prescribing. Assessment of prescriptions showed poor adherence to treatment guidelines, while most surgeons had a positive perception toward rational prescribing as per guideline recommendations.

Discussion

The current study focused on assessment of adherence to and surgeons' perceptions of SAP guidelines. We observed a substantial proportion of inappropriate SAP practices with

evidence-based standard treatment guidelines. Findings revealed poor compliance to treatment guidelines, with only 9.5% (n = 80) of patients receiving SAP as per guidelines. These findings are consistent with other studies conducted in Italy (15) and Brazil (16), which reported adherence rate of 5.7% and 3–5.8%, respectively. However, in contrast, higher adherence rates were reported in Qatar (68%) (17), India 52% (18) and Philippines (44%) (19). To ensure appropriate use of SAP, the first step is to provide educational training with an antibiotic stewardship programme and awareness regarding its importance. Previous studies have demonstrated the benefits of educational intervention for appropriate antibiotic prophylaxis. Studies in Nigeria (10) and Italy (15) found that compliance with antibiotic prophylaxis guidelines improved with increased awareness among surgeons and other healthcare team members.

Appropriate timing of administration of SAP was 40% (n = 338) in our study. Mixed results were found in the literature. The current findings are comparable with studies in the Philippines and Australia (19, 20). Studies in Northern Nigeria (16.5%) (10) and Egypt (5%) (21) reported lower adherence rates, whereas higher adherence rates were reported in Jordan (99%) (22), France (76.6%) (23) and Palestine (60%) (24). This is evidence that delayed administration of SAP is associated with a 2 times greater risk of SSIs as compared to timely administration (10). Appropriate time of administration of SAP could also reduce the duration of stay and hospitalization cost (4,12).

A possible explanation of the poor adherence rate in the present study is nonavailability of standard guidelines and protocols for antibiotic prophylaxis in these hospitals (10,25). Lack of knowledge, unavailability of clinical pharmacists and poor collaboration with healthcare teams are other possible reasons for noncompliance. Further, large scale and multicentre studies are needed to identify other contributing factors to noncompliance.

The most commonly prescribed SAP was ceftriaxone, which was administered to 503 (59.5%) cases. In line with our findings, studies in Ethiopia (6) and Turkey (26) also reported that ceftriaxone was excessively and inappropriately used in their settings. Antibiotics should be cost-effective, nontoxic and with a limited spectrum (4, 24). Cefazolin is sufficient to cover pathogens involved in SSI. Inappropriate use of antibiotics provides a favourable environment for microbial resistance and increases the possibility of adverse reactions (4,12). However, we observed a low level of cefazolin use in our study, which is in line with studies in the Islamic Republic of Iran (27) and Saudi Arabia (28). These findings revealed that the surgical team is not keeping up to date with standards of best practice.

The second phase of our study aimed to assess surgeons' perception regarding antibiotic prescribing according to standard guidelines in surgical wards in Pakistani hospitals. Most of the

respondents perceived that overuse of antibiotics, preference of broad-spectrum antibiotics and nonavailability of antibiotics were the main problems in surgical wards. Similar findings are also reported in other studies worldwide (8,14,18). Studies in Malaysia and India reported that surgeons perceived that broad-spectrum antibiotics with long duration are more effective than narrow-spectrum antibiotics (14,18). These findings are important to address because overuse, broad-spectrum antibiotics, and nonavailability problems have a potential impact on patient care and infection control activities.

The importance of evidence-based treatment guidelines cannot be denied. Prescribers scored highly for the guideline adherence items in the current study, which suggests a general acceptance of evidence-based guidelines. Guideline adherence scores were similar to other studies conducted in the United Kingdom of Great Britain and Northern Ireland (8) and France (29). This reflects a positive attitude and preference of prescribers towards guidelines. Standard treatment guidelines are crucial for rational use of therapy. Updated and evidence-based guidelines should be provided to prescribers that ultimately enhance effective and quicker appropriate use of antibiotics (30). Most of the participants in our study reported that they used guidelines on a daily basis but also reported nonavailability of hospital-based local guidelines. Similar results were reported in the Philippines (31). Although positive attitudes towards guidelines were shown in our study they had a limited impact on practice. However, the reasons behind nonadherence to guidelines in our study may be lack of awareness of appropriate guidelines, lack of consensus by the surgeons with the guidelines, ineffective distribution system for the latest version of guidelines, and lack of regular educational training sessions (14).

The current findings of alarmingly low adherence rates to treatment guidelines imply that serious practical measures should be taken by hospital administrators and policy-makers to improve prescribing practice. Poor prescribing practice results in poor treatment outcomes and serious consequences such as higher incidence of adverse reactions, waste of resources and increased treatment costs. Most surgeons perceived that local hospital-based treatment guidelines are a prerequisite to improve prescribing practice and ultimately patient care. Also, measures should be taken to fill the gap between prescribers' perception and practice. Pharmacists could play a vital role in the development of evidence-based hospital guidelines and antibiotic stewardship programmes (32–34). Most of the participants in our study agreed about the important role of hospital pharmacists in the development of guidelines. However, in our setting, the pharmacists' role was mainly confined to dispensing drugs and not development of guidelines and decision-making. There is an urgent need for policies to be implemented by governments, hospital administrations and clinical teams of surgeons to acknowledge and support the vital role of hospital pharmacists. Prolonged working time, decreased workload and increased numbers of hospital pharmacists may be important strategies to monitor antibiotic use and development of guidelines for surgical patients. Such interventions are the key to success of antimicrobial stewardship programmes (33).

The current study had access to well-reported data on SAP and was adequately powered; however, some limitations must be acknowledged. First, the present study only focused on compliance rate of SAP in 3 common surgical procedures. Second, we used published recommendations of evidence-based international guidelines to measure against the appropriate use of SAP in selected operations because there were no local consensus guidelines available in both hospitals. However, the possibility exists that recommendations given by the guidelines were not practicable in our patients or for the situation in Pakistan. Third, the study did not monitor postoperative infection rate. Therefore, we do not know if nonadherence to the guidelines had any clinical consequences. Moreover, the questionnaire was only distributed to 2 tertiary care hospitals in Islamabad. Therefore, these findings cannot be generalized for the whole country. However, these findings do add useful information, particularly around appropriate antibiotic use, adherence to standard guidelines, perception of surgeons, and factors that affect antibiotic prescribing in surgery and health systems in developing countries.

Conclusions

Our findings indicates poor adherence to evidenced-based guidelines for administration of SAP. Surgeons have positive perception that antibiotics should be used according to guideline recommendations. Most surgeons perceive that poor adherence to treatment guidelines is due to poor awareness, underestimation of infection, lack of consensus and disagreement with guideline recommendations. The results provide evidence that healthcare providers should be aware of their larger role in reducing inappropriate antibiotic prescription prior to surgery. Good prescribing practices are crucial for patient safety and better health outcomes, although prescribers still rely on their own personal experiences while prescribing therapeutic agents. Compliance with guidelines by surgeons remains a challenge, as reported by previous studies worldwide and in the present study. Nonadherence with guidelines may have increased antibiotic resistance and healthcare-associated infection rates. Real actions are urgently needed for the implementation of guidelines and to address the related factors of such practices. Continuous educational training, availability of appropriate antimicrobials, and implementation of local and international treatment guidelines and antimicrobial stewardship programmes are required for appropriate utilization of SAP. Furthermore, our findings suggest that large-scale multicentre studies should be conducted to evaluate the factors that affect antibiotic prescribing across the provinces of Pakistan.

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Competing interests: None declared.

Audit de l’antibioprophylaxie et de l’observance des lignes directrices standard par les chirurgiens dans les actes courants de chirurgie abdominale

Résumé

Contexte : L’usage prophylactique des antibiotiques préalablement à un acte chirurgical est une pratique fondée sur des données probantes, qui permet de prévenir les infections du site opératoire (ISO).

Objectifs : Étudier l’observance des lignes directrices en matière d’antibioprophylaxie et le point de vue des chirurgiens sur cette pratique.

Méthodes : Une étude prospective transversale en deux phases, a été menée dans deux hôpitaux universitaires. Phase 1 : Audit des ordonnances sur six mois, afin d’évaluer le taux de d’observance des lignes directrices fondées sur des données probantes. Les informations importantes ont été recueillies à partir des dossiers médicaux au moyen d’un formulaire conçu à cet effet. Phase 2 : un auto-questionnaire a été utilisé pour étudier le point de vue des chirurgiens. Des statistiques descriptives ont été produites, un test de Kruskal-Wallis sur échantillons indépendants et une analyse de régression linéaire multivariée ont été réalisés à l’aide du logiciel SPPS, version 21.0.

Résultats : Au total, 866 cas chirurgicaux répondant aux critères de l’étude ont été examinés : appendicectomies aiguës, (n = 418, soit 48,2 %), cholécystectomies laparoscopiques, (n = 278, soit 32,1 %) et hernies inguinales (n = 170, soit 19,7 %). Une antibioprophylaxie chirurgicale a été prescrite dans 97,5 % des interventions. Parmi ces dernières, le respect des lignes directrices était de 9,5 % pour le choix de l’antibiotique, de 40 % pour le moment de l’administration et de 100 % pour la dose et la voie d’administration, la valeur optimale étant 100 %. La majorité des patients ont reçu de la ceftriaxone (n = 503, soit 59,5 %) comme antibiotique prophylactique. Le questionnaire a été rempli par 200 chirurgiens, avec une cohérence interne satisfaisante ($\alpha \geq 0,7$). Plus de la moitié (69 %) des participants estimaient que les antibiotiques étaient surutilisés. La majorité des chirurgiens pensent que l’observance médiocre des lignes directrices de traitement est due à un manque de sensibilisation, à une sous-estimation de l’infection, à l’absence d’un consensus et à un désaccord avec les recommandations de ces lignes directrices.

Conclusions : Les chirurgiens approuvent l'usage des antibiotiques conformément aux recommandations des lignes directrices de traitement. Cependant, notre étude révèle une observance médiocre de ces textes dans les traitements d'antibioprophylaxie.

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المشاركين في الاستبيان (69 %) أن هناك زيادة في استعمال المضادات الحيوية . كما رأى
معظم الجراحين أن السبب وراء ضعف الامتثال بالمبادئ التوجيهية للعلاج يرجع إلى ضعف
الوعي، وعدم تقدير الحجم الحقيقي للعدوى، وغياب التوافق في الآراء، والاختلاف مع
التوصيات الخاصة بالمبادئ التوجيهية .

: لدى الجراحين منظور إيجابي بشأن ضرورة استعمال المضادات الحيوية وفقاًالاستنتاجات
لما ورد في التوصيات الخاصة بالمبادئ التوجيهية، لكن لوحظ ضعف الامتثال للمبادئ
التوجيهية الخاصة بالعلاج بالمضادات الحيوية الوقائية .

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