Original Article

Appropriate Antibiotic Administration in Elective Surgical Procedures: Still Missing the Message

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OBJECTIVE: The aim of this study was to determine the appropriateness of antibiotic prophylaxis in selected elective surgical procedures in a tertiary referral centre.

METHODS: A cross-sectional study using retrospective data from January 2000 to May 2002 was performed pertaining to elective colorectal surgery, cholecystectomy and inguinal hernia repairs. Appropriateness of antibiotic administration was determined based on compliance with national and internationally accepted guidelines on prophylactic antibiotic prescribing policy. A single dose or omission of antibiotic administration was judged appropriate for cholecystectomy and inguinal hernia repair, while up to 24 hours’ dosing was considered appropriate practice for colorectal surgery.

RESULTS: Of 419 cases, there were 55 (13.1%) colorectal procedures, 97 (23.2%) cholecystectomies and 267 (63.7%) inguinal hernia repairs. Antibiotics were administered in a total of 306 (73%) cases, with single-dose prophylaxis in only 125 (41%) of these. Prophylaxis was inappropriately prolonged in 80%, 52% and 31% of colorectal, cholecystectomy and inguinal hernia cases, respectively. The corresponding mean duration of antibiotic administration was 2.4 ± 2.2, 1.6 ± 1.8 and 1.1 ± 1.3 days, respectively.

CONCLUSION: Antibiotic prophylaxis in elective surgery continues to be administered haphazardly. This study supports close surveillance of antibiotic utilization by a dedicated team, perhaps consisting of microbiologists or pharmacists, to minimize inappropriate administration. [Asian J Surg 2005;28(2):104–8]

Key Words: antibiotic prophylaxis, elective surgery

Introduction

Postoperative wound infection is a health care burden as it increases the length of hospital stay, drains resources and decreases productivity.1 Antibiotic prophylaxis has played a major role in reducing this morbidity and is well established in numerous surgical procedures. Apart from the safety profile, to be appropriate, antimicrobial prophylaxis should be active against the pathogens most likely to contaminate the wound and be given at appropriate doses and for the shortest effective period in order to minimize cost and adverse effects.

There has, however, been an overzealous response to antibiotic administration including that related to the field of surgery, where the surgeon constantly aims to maintain high standards by keeping morbidity and mortality rates to a minimum. During the 1970s, studies revealed that antibiotic prophylaxis was inappropriate in more than half of all hospitalized patients who received it.2,3 Indications for prophylaxis, the choice of antibiotic and the duration of cover were not well understood; a better understanding of antibiotic prophylaxis gradually emerged in the ensuing years. Song and Glenny, in their systematic review of antibiotic prophylaxis in colorectal surgery, summed up the general principles related to adverse

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effects of prolonged chemoprophylaxis, reminding surgeons that antibiotics are not a substitute for poor surgery. There is little disagreement with the fact that the medical fraternity administers antibiotics haphazardly, often ignoring evidence-based guidelines and disregarding the boundaries between prophylactic and therapeutic antibiotic administration.

We have previously identified, in a national survey, a 73% rate of excessive or inappropriate antibiotic administration in elective colorectal surgery, and we believe that the influence of published national guidelines on antibiotic administration is poor. The aim of this study was to determine the appropriateness of antibiotic administration in elective general surgical procedures in a tertiary referral centre.

Patients and methods

This was a hospital-based, cross-sectional study using retrospective data from January 2000 to May 2002. It was conducted at Kuala Lumpur Hospital, which is a tertiary referral centre in Malaysia with a total of 2,396 beds, of which 170 are surgical beds. The inclusion criteria for the study were adult patients (>16 years) undergoing elective colorectal surgery, laparoscopic as well as open cholecystectomy or inguinal hernia repair. Colorectal procedures only included cases associated with a laparotomy or laparoscopy. Both mesh and non-mesh inguinal hernia repairs were included. All emergency procedures and any elective cases that were complicated by inadvertent intraoperative contamination were excluded from the study. Any patients who developed an infective complication in the postoperative period requiring prolonged antibiotic therapy were also excluded from data analysis.

Appropriateness of antibiotic administration was determined based on compliance with updated evidence-based medicine and available national and local hospital guidelines (2000/1) on prophylactic antibiotic prescribing policy. For elective colorectal surgery, up to three doses of antibiotics was considered appropriate (single dose at induction and two further doses). No antibiotics or a single dose at induction was considered appropriate for the two remaining surgical procedures. For colorectal surgery, second- or third-generation cephalosporins with metronidazole was considered the first-choice prophylactic regimen, while for patients undergoing cholecystectomy and hernia repairs, second- or third-generation cephalosporins were recommended as prophylactic agents of choice. Amoxicillin-clavulanic acid and gentamicin were classified as alternative suitable antimicrobial prophylaxis for patients undergoing cholecystectomy. These antibiotic choices take into consideration local antibiotic resistance patterns for community-acquired infections.

Frequency distribution and cross-tabulation were used to determine the proportion of types of antibiotic prophylaxis administered, route of administration and duration of coverage of antibiotic prophylaxis for different elective surgical procedures. One-way analysis of variance (ANOVA) was used to determine the association between duration of coverage and different types of elective surgical procedures (p < 0.05). Data were analysed using SPSS version 10.0 (SPSS Inc, Chicago, IL, USA).

The estimated direct cost attributable to inappropriate antibiotic administration in elective surgery was calculated according to the prices quoted in the Drug Index of Malaysia and Singapore (DIMS) published in 2001.

Results

A total of 684 patients underwent elective surgical procedures in the form of colorectal surgery, cholecystectomy or inguinal hernia repair between January 2000 and May 2002. Records for 495 patients (72.4%) were retrieved, 76 of which were excluded because data were incomplete or did not meet the inclusion criteria. Therefore, 419 (61.3%) remaining cases were available for data analysis, of which 55 (13.1%) were colorectal surgical procedures, 97 (23.2%) were cholecystectomies, and 267 (63.7%) were inguinal hernia repairs. The retrieval rate of the case notes in this study was low, which is in keeping with the results of other retrospective studies conducted in this hospital. This is attributed to the current filing system in the hospital, which resorts to storage of case notes in facilities outside the main hospital area due to space limitation, hampering retrieval of data outside a certain time frame.

Colorectal surgical procedures included 13 (24%) segmental or semi-colectomies, 21 (38%) anterior resections, nine (16%) abdominoperineal resections, four (7%) sigmoid colectomies and eight (15%) Hartmann’s procedures. Of 97 cholecystectomies, 63 (65%) were performed through the laparoscopic route. There were 218 (82%) cases of mesh inguinal hernia repair and 49 (18%) of non-mesh repair. Antibiotics were administered in 73% (305) of elective surgical procedures. Prophylaxis was used in 98.2% (54) of colorectal surgical procedures, 95.9% (93) of cholecystectomies and 59.6% (159) of inguinal hernia repairs. The most common prophylactic antibiotic administered in colorectal surgery was a combination of cefoperazone plus metronidazole (77.8%), followed by cefuroxime with metronidazole (9.3%) and amoxicillin...
Clavulanic acid plus metronidazole was administered in 5.6% of cases. The most common antibiotic administered in cholecystectomies was a combination of cefoperazone and metronidazole (69.9%), followed by cefoperazone alone (11.8%) and amoxicillin-clavulanic acid alone (7.5%). Amoxicillin-clavulanic acid was administered in 81 (50.9%) inguinal hernia repair cases and cefoperazone alone in 27 (17.0%).

The antibiotic used was considered appropriate in 87% of colorectal surgical procedures, 84.3% of inguinal hernia repairs and only 22.6% of cholecystectomies. Prophylactic antibiotics were given primarily through the intravenous route (96.7%) in all three procedures. In 98% of cases, the first dose was given at induction (Table 1). Oral and intramuscular routes constituted 1.3% and 2% of cases, respectively.

Antibiotic prophylaxis was given for more than 24 hours in 139 (33.2%) cases (Table 2). The overall mean duration of coverage for antibiotic prophylaxis in elective surgery was 1.6 ± 1.8 days. In colorectal surgery, the mean duration of prophylaxis was 2.4 ± 2.2 days, while the corresponding figures for cholecystectomy and hernia repair were 1.6 ± 1.8 and 1.1 ± 1.3 days, respectively. There was a significant difference between duration of antibiotic prophylaxis coverage and type of elective surgery (ANOVA = 38.132, df = 2, p < 0.001).

Of 54 cases of colorectal surgical procedures for which antibiotics were administered, 44 cases (81.5%) were considered to have had inappropriate dosing exceeding the stipulated duration of 24 hours. For patients undergoing cholecystectomy and inguinal hernia repair, 50 (51.6%) and 83 (31.1%) cases, respectively, had inappropriately prolonged antibiotic prophylaxis exceeding a single dose (Table 2). The difference between types of elective surgery and doses administered (single and multiple doses) was statistically significant ($\chi^2 = 24.059$, df = 2, p < 0.001) (Figure).

The direct cost of inappropriate antibiotic administration during the study period was calculated at US$12,057. Colorectal surgery was responsible for the highest cost (39%) in relation to inappropriate antibiotic administration in this study. This was followed by cholecystectomy (34%) and inguinal hernia repair (27%).

Discussion

Appropriateness of antibiotic prophylaxis is usually determined by the choice of antibiotics used, route of administration, timing of administration and duration of coverage as well as cost of antimicrobial regimens. While the benefits of antibiotic prophylaxis include prevention of morbidity and mortality as well as reduction in duration and cost of hospitalization, inappropriate use of antibiotic prophylaxis can have disadvantages such as the development of resistant strains.4,7

The necessary duration of postoperative antimicrobial prophylaxis is often unclear,8 but it is vital that the shortest effective course of prophylactic antibiotics is used, with longer half-life antibiotics usually preferred as a “single-shot”

### Table 1. Timing of first prophylactic antibiotic dose in elective surgery

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<tr>
<th>Time of administration</th>
<th>Total, n (%)</th>
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<tbody>
<tr>
<td>Induction</td>
<td>Postoperative</td>
</tr>
<tr>
<td>Colorectal surgery, n (%)</td>
<td>54 (100)</td>
</tr>
<tr>
<td>Cholecystectomy, n (%)</td>
<td>93 (100)</td>
</tr>
<tr>
<td>Inguinal hernia repair, n (%)</td>
<td>153 (96.2)</td>
</tr>
<tr>
<td>Total, n (%)</td>
<td>300 (98.0)</td>
</tr>
</tbody>
</table>

### Table 2. Prophylactic antibiotic use in colorectal surgery, cholecystectomy and inguinal hernia repair

<table>
<thead>
<tr>
<th>Antibiotic prophylaxis coverage</th>
<th>Total, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>1 (1.8)</td>
</tr>
<tr>
<td>Single dose</td>
<td>4 (4.1)</td>
</tr>
<tr>
<td>Up to 24 hr</td>
<td>108 (40.4)</td>
</tr>
<tr>
<td>Up to 48 hr</td>
<td>80 (27.0)</td>
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<td>&gt; 48 hr</td>
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therapy. Single-dose antibiotic administration has often been cited as sufficient to lower postoperative wound sepsis following elective colorectal surgery, and this was essentially confirmed by Song and Glenny in their systematic review.

Although sufficient data exist supporting the use of single-dose regimens, our national survey conducted in 2000 on antibiotic prescribing policy in elective colorectal surgery revealed that about 73% of surgeons used more than a single-dose regimen. A local study on antibiotic prescribing patterns in surgical practice in 1994 found that only 4.9% of antibiotics prescribed were of a day’s duration, and that approximately 36% of prophylactic prescription did not specify the duration of administration. The present study was conducted as a follow-up to these studies to determine whether any changes in prescribing patterns had emerged recently.

Hospitals in Malaysia have guidelines prepared by an expert committee relating to antibiotic administration policy, which recommends the use of a single prophylactic dose of antibiotics during elective colorectal surgery and cholecystectomy. Even though antibiotic prophylaxis is not recommended for inguinal hernia repairs, the increasing use of mesh repairs would justify the use of a single antibiotic dose.

An interesting observation pertaining to the choice of antibiotic prophylaxis in colorectal surgery was the use of amoxicillin-clavulanic acid with metronidazole in 5.6% of cases despite awareness of duplicate anaerobic coverage that is conferred by this combination. Close to 70% of patients undergoing cholecystectomy were administered an inappropriate combination of cephalosporin and metronidazole, even though it is understood that the use of metronidazole is usually reserved for diabetics and patients who are immunosuppressed. Even though the necessity for antibiotic prophylaxis in laparoscopic cholecystectomy is questionable, as demonstrated by results from recent studies and comprehensive guidelines produced by the well-established Scottish Intercollegiate Network, a single antibiotic dose was accepted as appropriate in the current study as recommended by the local guidelines on antibiotic prophylaxis. Our findings confirm the worrying trend that exists in the practice of antibiotic prophylaxis in elective surgery, where a large proportion continues to be administered excessively.

Antibiotics administered for perioperative prophylaxis form a considerable part (one-third in many hospitals) of all antibiotic prescriptions. Appropriate administration of prophylactic antibiotics reduces the duration of hospitalization and consequently reduces the overall health care burden from a financial perspective. In this study, the estimated direct cost attributable to inappropriate antibiotic administration in elective surgery was US$12,057. This figure should not be underestimated as it only represents the direct cost attributed to a few selected surgical procedures, in addition to the fact that only 61% of the case notes were available for analysis.

The reason for inappropriate prophylactic antibiotic administration may be multifactorial. Failure to keep up to date and reliance on habit rather than on evidence-based practice are two possible reasons for this. Lack of institutional policies and failure to enforce regulations are other responsible factors that can easily be modified to achieve sensible antibiotic scheduling policy. Furthermore, the busy physician may inadvertently neglect to terminate an antibiotic course after a reasonable period of administration.

This study supports close surveillance of antibiotic administration among hospital physicians who may be unaware of the duration of antibiotic administration in their patients. A dedicated team consisting of microbiologists or pharmacists may have a role to play in minimizing inappropriate antibiotic administration, and this should be complemented by the active involvement of the nursing staff. The hospital’s infection control and quality assurance committee should review compliance with recommended guidelines for prophylactic antimicrobial administration regularly and take remedial action in the case of unsatisfactory results. Attempts to highlight discrepancies through regular audits can lead to appropriate action to improve the standards of practice in antibiotic prescribing. Workshops and seminars on knowledge of antibiotic prophylaxis should be conducted from time to time, and the respective health authorities should provide information for medical personnel in hospitals via drug bulletins or newsletters or perhaps on regularly updated Internet web sites.

The busy practitioner who seeks an excuse for the difficulty he or she faces in keeping up to date with evidence-based...
medicine should rely on formal clinical guidelines as an acceptable means of adopting safe clinical practice. This will hopefully reduce the haphazard abuse of antibiotic administration and its undesirable consequences. Apart from the widespread proactive methods outlined above, respective health authorities should implement tougher measures to halt unhealthy prescribing patterns associated with injudicious use of antibiotics.

References