ASSESSMENT OF ANTIBIOTIC USE IN OLDER ADULTS UNDERGOING ACUTE CARE SURGERY: A RETROSPECTIVE STUDY OF PROPHYLACTIC AND THERAPEUTIC PRACTICES

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Abstract

Background: This retrospective study aims to characterize antibiotic use among older adults admitted to acute care surgery services at a tertiary care teaching hospital, with a focus on evaluating adherence to published antibiotic prescribing guidelines. **Methods**: Data on diagnoses, chronic conditions, surgeries, and antibiotic administration were collected for 906 patients admitted to the hospital. Of these, 458 patients underwent surgery, primarily for small bowel obstruction and acute cholecystitis. The use of perioperative antibiotic prophylaxis was assessed for 502 non-elective abdominal surgeries, and antibiotic prescribing practices were compared to published guidelines. **Results**: 50.5% of patients undergoing non-elective abdominal surgery received perioperative antibiotic prophylaxis. Errors in antibiotic administration were identified, with 16.5% of patients receiving antibiotics at incorrect times and 13.4% receiving incorrect doses. 45.2% of patients received appropriate first-line antibiotics for their underlying condition. Inappropriate use of second or third-line antibiotics, as well as unnecessary use of first-line agents, was observed in a significant proportion of patients. Treatment duration varied significantly among patients with the same diagnosis. **Conclusion**: The findings highlight a need for quality improvement initiatives to optimize antibiotic prescribing practices, minimize errors, and ensure optimal care for older surgical patients in complex hospital settings.

Keywords:
Antibiotic use, Older adults, Acute care surgery, Perioperative antibiotic prophylaxis, Surgical patients, Antibiotic prescribing practices

Introduction

Antibiotics are widely used in hospitals, with over half of all acute care patients receiving them for the treatment of infections acquired in the community or during hospitalization [1]. However, studies have shown that up to 50% of antibiotic use may be unnecessary or inappropriate [2-4]. This can lead to the development of antibiotic-resistant bacteria, prolonged hospital stays, and adverse reactions. Additionally, inappropriate use of antibiotic prophylaxis may increase the risk of wound infections [5]. Although surgery checklists are in place, they are often insufficient in ensuring adherence to antibiotic guidelines [6-8]. Infections are common in older adults, and

antibiotics are frequently used for both treatment and prophylaxis. However, the use of antibiotics in older patients undergoing acute care general surgery has been poorly studied. Given the susceptibility of older adults to antibiotic misuse, this study is necessary. Factors such as the high volume of diverse patients, frequent handovers, rotating surgeon coverage, and the involvement of trainees in decision-making may contribute to increased risk of antibiotic errors in this setting.

Objective

This study aimed to examine antibiotic use among older adults admitted to an acute care surgical service at a tertiary care teaching hospital.

Methods

Participants were prospectively identified and consented during their hospital admission. Data were collected retrospectively on demographics, diagnoses, allergies, comorbidities, treatments, surgeries, and antibiotic administration. Information was gathered from multiple hospital units, including the emergency department (ED), general surgery ward, intermediate care unit (IMCU), intensive care unit (ICU), and operating room (OR). For each patient, the type, dose, frequency, and route of antibiotics administered were recorded. Prophylactic antibiotic use was assessed based on OR start times and the times at which antibiotics were administered. Additionally, the appropriateness of prophylactic antibiotics was evaluated based on the time of day they were administered: daytime (7:30 am–4:59 pm), evening (5:00 pm–11:59 pm), or nighttime (12:00 am–7:29 am).

Antibiotic use was assessed in accordance with center-specific guidelines for surgical prophylaxis, which aligned with published guidelines and considered local resistance patterns [13–16]. These guidelines were available online and in handbooks, but no specific educational initiatives were introduced to influence prescriber behavior. Each antibiotic prescription was independently evaluated and classified as either appropriate or inappropriate. In cases of uncertainty, an infectious disease physician was consulted for clarification.

Criteria for Appropriateness

Antibiotic prophylaxis was considered appropriate if the antibiotics were administered within 60 minutes of incision or if antibiotics were given therapeutically prior to surgery. Additionally, the prescribed antibiotic dose and agent were assessed for compliance with guidelines. If the recommended dose and antibiotic were administered, or if no antibiotics were required, the prescription was considered appropriate. Alternative guideline-recommended antibiotics were considered in cases where the prescribed antibiotics differed, taking patient allergies into account.

Exclusion Criteria

Antibiotics used for conditions other than surgical disease prevention or treatment were not evaluated in this study.

Results

Over the course of the study, 906 elderly patients were admitted to acute care general surgery. In most cases, the diagnosis was acute cholecystitis (Table 1). 458 patients had surgery, and 448

were nonoperative. A total of 200 hospitalized patients spent time in the IMCU and 124 spent time in the ICU during their hospital stay. A total of 678 patients received antibiotics during their hospital stay. The majority of patients had no antibiotic allergies or intolerances. The patients were sensitive to penicillin, sulfonamide, and macrolides. Twenty patients had multiple antibiotic intolerances. Antibiotics were given to patients with allergies.

Antibiotic prophylaxis

The number of nonelective abdominal operations performed on 458 patients totaled 502 in total. It was found that the most common procedures performed were laparoscopic cholecystectomy (19.5%), large bowel resection (20.3%), small bowel resection (13.5%), and adhesion removal (13.1%). The majority of surgeries were classified as clean-contaminated (54.2%), followed by clean (20.7%), dirty (19.9%) and contaminated (5.2%). It was determined that all surgeries required prophylactic antibiotics, which were administered in 223 (89%). As a result, antibiotics were administered in 376 cases as prophylactic measures in the operating room, and antibiotics were used preoperatively for therapeutic purposes in 70cases to provide adequate prophylactic measures. Overall, 49.5% of cases were appropriately covered by prophylactic antibiotics during the period of intervention. The most common error in the administration of antibiotics was the timing of the administration (Table 2). The antibiotics were given in 78% of these cases after the incision, and in 22% of them too early in general. There were more than one error in 50 of the cases. As a result of being performed at night, more appropriate prophylactic antibiotics were used (35.5%) compared to daytime and evening procedures. However, this did not prove to be a statistically significant finding.

Antibiotic use for therapeutic purposes

Of 906 admitted patients, 672 (74.2%) received appropriate antibiotic treatment. A total of 234 cases were inappropriately treated, 156 involved non-first line antibiotics when first line antibiotics would have been appropriate, 50 involved antibiotics that were not indicated, and 28 had additional antibiotic therapy that was not given. Neither allergies nor drug interactions contributed to antibiotic errors. 412 out of 906 patients (45.5%) were prescribed antibiotics for their surgical disease or intra-abdominal complication in the course of their surgery. These patients were prescribed 1152 antibiotics. There were 15.5% of therapeutic antibiotics prescribed for intra-abdominal septic complications, 15.5% for acute cholecystitis, 12.6% for diverticulitis, 10.7% for ischemic colitis, and 8.3% for cholangitis. Treatment with therapeutic antibiotics lasted an average of eight days, and 68 (15.0%) of the patients admitted to the hospital were prescribed antibiotics. The nature and duration of antibiotic therapy for many common surgical problems varied considerably (Table 3).

Table 1: Demographic and clinical characteristics

Characteristic	Median [IQR] or %
Age, in years	79
The female gender	54.2
Body Mass Index	29.6
LOS, d	12
Diagnosis at admission	

Small bowel obstruction	28.2
Cholecystitis acute	12.0
Lower gastrointestinal bleeding	8.9
Diverticulitis	6.7
No obstruction, incarcerated hernia	6.3
Ischemic colitis	5.9
Pancreatitis due to gallstones	5.6
Colorectal cancer	5.4
Cholangitis	5.3
Intra-abdominal abscess	3.9
Choledocholithiasis	3.2
Others	20.6

Table 2: Perioperative prophylactic antibiotic administration

Error	No. (%)*
Timing incorrect (not within 60 minutes of incision)	16.5
Incorrect dose	13.4
Antibiotics indicated, not given	12.2
Not needed, additional antibiotics given	9.0
Needs additional antibiotics	7.0
First-line antibiotic wrong	6.2
Redose missed or incorrect	2.6

A review of individual prescriptions revealed that 898 (78.0%) were appropriate for treating surgical pain or complications. A substitute antibiotic was available for 196 of 926 prescriptions associated with the admission diagnosis. In 11.2% of prescriptions, cefazolin was identified as an alternative to amoxicillin-clavulanate (5.4%). Cefazolin was the first-line antibiotic recommended for the treatment of 50 cases where ciprofloxacin was used and 48 cases where ceftriaxone was used. Nine ciprofloxacin prescriptions and 36 metronidazole prescriptions were filled with amoxicillin-clavulanate. The antibiotic was unnecessary in 5.6% of surgical disease prescriptions, either because other antibiotics covered it or there was no indication for its use.

Discussion

Antibiotics used in acute care general surgery for therapeutic and prophylactic purposes. Acute care surgery aims to reduce mortality and morbidity, but complex system factors result in errors. [18, 19] Frequent suboptimal transfers of care may result in poor care. The older adults in these services commonly have multiple comorbidities and evolving medical needs. [20] They may have high turnover among staff, surgeons, and trainees. Urgent surgery patients cannot afford to optimize their health status preoperatively as would elective surgery patients. As a result of these factors, acute care patients are more likely to be subjected to medical errors, such as indiscriminate antibiotic use [20]. It is important to optimize antibiotic use in hospitals for 2 reasons, even when there is no definitive evidence of infection. As a first step, inappropriate

antibiotic therapy results in several adverse outcomes, including prolonged hospitalizations and increased healthcare costs.

Table 3. Usage of therapeutic antibiotics

Primary admission diagnosis	Antibiotics indicated, %	Antibiotics received, %	Appropriate treatment, %	Discharged with antibiotic, %	Median [IQR] duration, d*
Cholecystitis acute	65.0	65.0	55.0	11.0	6
Ischemic colitis	200	200	64.6	55.5	26
Gallstones, pancreatitis	29.6	29.6	91.5	0.0	10
Cholangitis	200	90.5	43.1	37.8	10
An intra-abdominal abscess	200	200	54.8	70.2	36
Ulcer perforated	200	200	51.0	11.0	16
Simple diverticulitis	200	200	12.1	67.7	22
Abscess, diverticulitis	200	200	34.3	67.7	34
Diverticulitis, perforation	200	200	63.5	13.5	18
Acute appendicitis	51.0	51.0	76.0	13.5	14

In recent years, studies have continued to demonstrate disappointing rates of prophylactic antibiotic use. In acute care general surgery settings, prophylactic antibiotic errors are common. At the time of this study, "time outs" were used before incisions. During previous studies, inappropriate timing was found to be the most common error, particularly the delay in antibiotic administration following an injury. There may be many factors involved in such errors, such as poor communication between surgical staff and anesthesiologists, failure to comply with checklists, and competing care priorities. Studies have identified a perceived low importance, inconvenience, and impaired workflow as barriers to providing appropriate prophylaxis. It was also common to administer incorrect doses and omit antibiotics, both of which could have been caused by the inability to access prescribing guidelines. It has been largely prophylactic antibiotics that have been optimized for antibiotic prescribing in surgical settings. It has been shown that effective interventions include interdisciplinary guideline development, prescriber feedback and educational initiatives. Weiser and colleagues found that a surgical checklist is feasible, effective, and reduces complications and mortality associated with surgery in the acute surgical setting. Surgical safety checklists have been implemented at our institution recently. Through guidelines, individual performance feedback, and multidisciplinary strategies like education and reminders, A number of studies have evaluated persuasive, restrictive, and structural interventions aimed at reducing antibiotic misuse and improving prescribing among

hospitalized patients. It is possible to improve antibiotic use through both persuasive and restrictive interventions.

Conclusion

In an acute care general surgery service, 75 percent of older adults received antibiotics. Patients with the same diagnosis experienced considerable variation in therapeutic antibiotic treatment despite established evidence that antibiotic prophylaxis is beneficial. Aside from the guidelines and education that should be provided, quality improvement and quality assurance initiatives are also needed. In acute care, it is unclear which strategies will improve antibiotic use.

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