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Original Research Article

Single-Dose vs. Multi-Dose Antibiotic Prophylaxis in Major Clean-Contaminated Surgery: A Meta-Analysis

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Abstract

Background: The optimum duration of perioperative antibiotic prophylaxis in major clean-contaminated surgery remains debated in routine practice, particularly in settings where postoperative continuation is still common despite stewardship-oriented guidance.

Aim: To compare single-dose versus multi-dose antibiotic prophylaxis in major clean-contaminated surgery with respect to surgical site infection, antibiotic-associated morbidity, hospital stay, and direct prophylaxis cost.

Methods: This hospital-based comparative analytical study was conducted in the Department of General Surgery, Government Medical College & Hospital, Purnea, Bihar, India, from 15 February 2025 to 20 March 2026. Eighty adult patients undergoing major clean-contaminated operations were allocated to a single-dose prophylaxis group (n=40) or a multi-dose prophylaxis group (n=40) according to the institutional perioperative plan. Baseline characteristics, operative variables, timing and appropriateness of prophylaxis, 30-day SSI, antibiotic-related adverse events, length of stay, and cost were analyzed.

Results: Baseline profile and operative complexity were comparable between groups. SSI occurred in 4/40 (10.0%) patients in the single-dose group and 5/40 (12.5%) in the multi-dose group (OR 0.78, 95% CI 0.19-3.14; p=1.000). Single-dose prophylaxis markedly reduced postoperative antibiotic exposure (1.0 ± 0.0 vs 3.7 ± 1.1 days; p<0.001), total prophylactic doses (1.2 ± 0.4 vs 6.8 ± 2.1; p<0.001), direct prophylaxis drug cost (₹1280 ± 340 vs ₹2360 ± 520; p<0.001), and postoperative stay (5.2 ± 1.6 vs 6.1 ± 2.0 days; p=0.029). Antibiotic-associated adverse events were less frequent with single-dose prophylaxis (5.0% vs 22.5%; OR 0.18, 95% CI 0.04-0.90; p=0.048).

Conclusion: In major clean-contaminated surgery, single-dose prophylaxis provided SSI control comparable to multi-dose prophylaxis while offering clear stewardship, safety, and cost advantages. These findings support protocolized restriction of prophylaxis duration in uncomplicated clean-contaminated procedures.

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Introduction

Surgical site infection (SSI) remains one of the most frequent and consequential healthcare-associated complications after abdominal and general surgical procedures, particularly in low- and middle-income settings where perioperative systems, antimicrobial stewardship, and post-discharge surveillance are often inconsistent [1-4]. Clean-contaminated surgery occupies an especially important middle ground: the operative field is entered under controlled conditions, prophylactic antibiotics are indicated, yet the magnitude of benefit depends less on whether an antibiotic is given than on which agent is chosen, when it is administered, and how long it is continued [1-3]. Contemporary guidance from the CDC, WHO-associated recommendations, and major surgical prophylaxis frameworks consistently emphasizes an appropriate intravenous antibiotic before incision, adequate tissue levels at the time of contamination, intraoperative redosing when indicated, and discontinuation once prophylactic benefit ends rather than continuation by routine [1-4]. The duration component is particularly important. Historically, many surgeons favored postoperative continuation for 24 hours or several days, often justified by fear of SSI, drain placement, bowel handling, or concern about local contamination. However, the evidence base has steadily moved in the opposite direction. The modern prophylaxis paradigm is not "more

antibiotic for more protection," but a stewardship-oriented strategy in which a correctly timed single pre-incision dose—sometimes with intraoperative redosing—achieves most of the preventive benefit while avoiding unnecessary antimicrobial exposure [1-7]. Extended postoperative dosing has repeatedly failed to demonstrate meaningful superiority for routine clean-contaminated operations and may instead increase adverse drug effects, selection pressure for resistance, excess nursing workload, and avoidable cost [2,3,6,7].

This shift is supported by both guidelines and comparative studies. Bratzler and colleagues established that prophylactic regimens should be procedure-specific, appropriately timed, and generally limited in duration [1]. CDC SSI guidance further discouraged continuation after incision closure for clean and clean-contaminated procedures, even when drains are present [2]. The 2022 acute-care-hospital SSI prevention update reiterated that prophylactic antibiotics should not be continued after closure and should instead be integrated into a broader prevention bundle that includes asepsis, glycemic optimization, and perioperative process discipline [3]. The WHO-associated evidence synthesis likewise placed antimicrobial timing and avoidance of unnecessary postoperative continuation within a larger framework of SSI prevention and patient safety [4].

Recent evidence has sharpened this message. Tang et al. performed an updated systematic review and meta-analysis in 2024 and reaffirmed that antibiotic prophylaxis is beneficial in clean and clean-contaminated surgery when appropriately indicated, but the incremental value of prolonged exposure remains unconvincing [5]. A 2024 clinical review by Eckmann et al. summarized that perioperative prophylaxis should be narrowly targeted, brief, and embedded in stewardship principles rather than used as empiric postoperative therapy [6]. Seidelman et al. similarly emphasized that appropriate choice, timing, and dosing—not prolonged postoperative continuation—represent the antibiotic domains most relevant to SSI prevention [7].

Trial-level data in major clean-contaminated operations have been particularly informative. In elective oncologic clean-contaminated surgery, Nusrath et al. found that single-dose cefuroxime-based prophylaxis was not inferior to an extended four-day postoperative regimen for prevention of SSI and remote infection [8]. Mohri et al., in gastric cancer surgery, reported no clinically meaningful reduction in SSI with multiple-dose prophylaxis compared with single-dose prophylaxis [9].

Haga et al. reached a similar conclusion in elective gastric resection, where additional postoperative doses had little measurable impact on infection prevention [10]. Earlier systematic evidence in colorectal surgery also showed that short-course or single-dose approaches were broadly comparable to longer postoperative regimens when appropriate aerobic and anaerobic coverage was ensured [11,12]. Kannan et al. concluded that single-dose prophylaxis appears sufficient in many gastrointestinal oncologic procedures [13], and Marano et al. likewise found no clear advantage for multiple-dose regimens in upper gastrointestinal oncologic surgery [14].

At the same time, real-world practice often lags behind evidence. A 2025 prospective comparative study by Koppolu et al. involving 80 patients undergoing clean and clean-contaminated surgery reported no significant difference in SSI between single- and multiple-dose prophylaxis [15]. Ali et al. demonstrated striking non-adherence to guideline-recommended timing and duration in a developing-country setting, with prolonged prophylaxis remaining common [16]. Pereira et al. showed that even in a large university hospital, full compliance with prophylaxis protocols was uncommon and duration errors were among the most frequent deviations [17]. More recently, Bardia et al. analyzed noncardiac surgery at multicenter scale and showed that broader guideline nonadherence across antibiotic metrics remained associated with SSI risk [18].

In India, this question has added urgency because excess perioperative antibiotic use has direct implications for resistance ecology, affordability, and antimicrobial stewardship. Prolonged postoperative antibiotics often persist as a cultural habit in clean-contaminated surgery despite limited evidence of benefit. Such practice may be reinforced by concerns about hygiene, overcrowding, or delayed wound review, yet extending prophylaxis to compensate for systems issues is conceptually flawed [6,16,19,20]. Against this background, the present study was conducted at Government Medical College & Hospital, Purnea, Bihar, India, to compare single-dose and multi-dose antibiotic prophylaxis in major clean-contaminated surgery. We evaluated SSI together with antibiotic-associated adverse events, postoperative stay, and stewardship-relevant parameters. The primary hypothesis was that single-dose prophylaxis would be comparable in SSI prevention while reducing unnecessary antimicrobial exposure and related harms.

Materials and Methods

This hospital-based comparative analytical study was conducted in the Department of General Surgery, Government Medical College & Hospital, Purnea, Bihar, India, over the period from 15 February 2025 to 20 March 2026. The study included 80 consecutive adult patients undergoing major clean-contaminated surgical procedures involving controlled entry into the gastrointestinal, biliary, urinary, or female genital tract. Eligible

operations included upper gastrointestinal resections/anastomotic procedures, hepatobiliary operations, colorectal resections or stoma-related procedures, and selected urologic or gynecologic laparotomy/laparoscopic procedures classified as clean-contaminated according to standard wound definitions. Patients aged 18 years or above who provided consent and were planned for standard perioperative antibiotic prophylaxis were eligible. Patients with frank perforation, pre-existing intra-abdominal sepsis, dirty/infected wounds, therapeutic antibiotic requirement before surgery, severe immunosuppression, known active infection at another site, or reoperation for established postoperative infection were excluded.

The cohort was divided into two equal groups according to the perioperative prophylaxis strategy adopted by the treating surgical unit: a single-dose group (n=40), in which patients received one standard prophylactic dose before incision with intraoperative redosing only when indicated, and a multi-dose group (n=40), in which postoperative continuation was additionally prescribed for variable duration. The preferred regimen for gastrointestinal and hepatobiliary procedures was cefazolin plus metronidazole, with amoxicillin-clavulanate or piperacillin-tazobactam reserved for specific allergy, contamination-risk, or surgeon-preference situations. Timing of administration, need for redosing, and discontinuation within 24 hours were assessed against contemporary perioperative prophylaxis standards. All patients underwent standard anesthesia, skin preparation, and postoperative wound surveillance according to institutional practice.

Demographic variables recorded included age, sex, body mass index, comorbid diabetes, smoking or tobacco exposure, ASA category, procedure subgroup, surgical approach, urgency of operation, drain placement, operative duration, and blood loss. Antibiotic process variables included agent choice, timing within 60 minutes before incision, intraoperative redosing when indicated, total number of doses, and total prophylaxis duration. Clinical outcomes included 30-day surgical site infection, subclassified as superficial or deep/organ-space; remote postoperative infection; antibiotic-associated adverse events; culture positivity for multidrug-resistant organisms; postoperative length of stay; prolonged stay defined a priori as more than 5 days; and direct prophylaxis-related drug cost.

Data were entered into a structured study proforma and analyzed using SPSS-compatible statistical methods. Continuous variables are presented as mean ± standard deviation and were compared with the independent-samples t test. Categorical variables are presented as frequency and percentage and were compared using the chi-square test or Fisher's exact test as appropriate. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated for selected dichotomous outcomes. An exploratory multivariable logistic regression model was constructed for prolonged postoperative stay using prophylaxis strategy, emergency surgery, colorectal procedure, diabetes, age, and operative duration as covariates. A two-sided p value <0.05 was considered statistically significant.

Results

A total of 80 patients were analyzed, with 40 patients each in the single-dose and multi-dose prophylaxis groups. Baseline demographic profile, operative mix, and perioperative risk features were comparable between groups (Table 1). Mean age was 46.8 ± 12.4 years in the single-dose group and 48.1 ± 11.7 years in the multi-dose group (p=0.631). The distribution of upper gastrointestinal, hepatobiliary, colorectal, and urologic/gynecologic procedures was balanced, as were ASA class, diabetes prevalence, smoking exposure, urgency category, and minimally invasive approach use.

Intraoperative complexity did not differ significantly between groups (Table 2). Mean operative duration was 123.4 ± 31.8 minutes in the single-dose group and 128.9 ± 34.6 minutes in the multi-dose group (p=0.461), while mean blood loss was 184 ± 71 mL and 196 ± 79 mL, respectively (p=0.477). Appropriate antibiotic choice and timing before incision were high in both groups. However, the duration metrics differed sharply: all patients in the single-dose group were discontinued within 24 hours compared with only 20.0% in the multi-dose group (p<0.001). Mean prophylaxis duration was 1.0 ± 0.0 day versus 3.7 ± 1.1 days, and total prophylactic doses per patient were 1.2 ± 0.4 versus 6.8 ± 2.1 (both p<0.001).

Thirty-day SSI occurred in 4/40 (10.0%) patients receiving single-dose prophylaxis and 5/40 (12.5%) receiving multi-dose prophylaxis (OR 0.78, 95% CI 0.19-3.14; p=1.000) (Table 3). Most infections were superficial incisional events; deep or organ-space infection was uncommon in both groups. Remote postoperative infections were infrequent and showed no statistically significant difference. Antibiotic-associated adverse events were less frequent in the single-dose group (2/40, 5.0%) than in the multi-dose group (9/40, 22.5%) (OR 0.18, 95% CI 0.04-0.90; p=0.048). Multidrug-resistant isolate recovery was numerically lower in the single-dose arm (2.5% vs 10.0%), although this did not reach statistical significance.

Resource-use outcomes favored single-dose prophylaxis. Mean postoperative stay was significantly shorter with single-dose prophylaxis (5.2 ± 1.6 vs 6.1 ± 2.0 days; p=0.029), and mean direct prophylaxis drug cost was almost halved (₹1280 ± 340 vs ₹2360 ± 520; p<0.001). Prolonged stay beyond 5 days was observed in 27.5% of the

single-dose group and 47.5% of the multi-dose group, a clinically relevant but statistically non-significant difference on unadjusted analysis (OR 0.42, 95% CI 0.17-1.06; p=0.105). In the exploratory regression model, emergency surgery was the only independent predictor of prolonged stay (adjusted OR 4.02, 95% CI 1.33-12.10; p=0.013), whereas multi-dose prophylaxis showed a strong trend without reaching conventional significance (adjusted OR 2.49, 95% CI 0.92-6.77; p=0.072). The forest-style subgroup analysis (Figure 1) showed no procedural subgroup in which multi-dose prophylaxis demonstrated a convincing SSI advantage. Likewise, the comparative outcome diagram (Figure 2) illustrated the similar SSI rates but higher adverse-event burden, prolonged-stay frequency, and multidrug-resistant culture yield in the multi-dose group. Table 4 situates the present findings alongside recent trials, meta-analyses, and contemporary comparative evidence, all of which favor a shorter, more stewardship-concordant prophylaxis strategy in uncomplicated clean-contaminated surgery.

Table 1: Baseline demographic and operative profile of the study groups

Variable	Single-dose (n=40)	Multi-dose (n=40)	p value
Age (years)	46.8 ± 12.4	48.1 ± 11.7	0.631
Male sex, n (%)	24/40 (60.0)	23/40 (57.5)	1.000
BMI (kg/m²)	23.7 ± 3.6	24.2 ± 3.9	0.553
Diabetes mellitus, n (%)	8/40 (20.0)	9/40 (22.5)	1.000
Current smoker/tobacco exposure, n (%)	10/40 (25.0)	11/40 (27.5)	1.000
ASA class II/III, n (%)	19/40 (47.5)	21/40 (52.5)	0.823
Upper GI procedure, n (%)	10/40 (25.0)	11/40 (27.5)	0.804
Hepatobiliary procedure, n (%)	14/40 (35.0)	13/40 (32.5)	0.810
Colorectal procedure, n (%)	9/40 (22.5)	10/40 (25.0)	0.786
Urologic/gynecologic procedure, n (%)	7/40 (17.5)	6/40 (15.0)	0.744
Elective surgery, n (%)	30/40 (75.0)	29/40 (72.5)	0.793
Laparoscopic/minimally invasive approach, n (%)	18/40 (45.0)	17/40 (42.5)	0.823

BMI: body mass index; ASA: American Society of Anesthesiologists.

Table 2: Operative characteristics and prophylaxis-process metrics

Variable	Single-dose (n=40)	Multi-dose (n=40)	p value
Operative duration (min)	123.4 ± 31.8	128.9 ± 34.6	0.461
Estimated blood loss (mL)	184 ± 71	196 ± 79	0.477
Drain placed, n (%)	11/40 (27.5)	12/40 (30.0)	1.000
Appropriate antibiotic selection, n (%)	37/40 (92.5)	36/40 (90.0)	0.692
Administration within 60 min before incision, n (%)	35/40 (87.5)	36/40 (90.0)	1.000
Redosing indicated, n	9	10	—
Correct intraoperative redosing among indicated cases, n/N (%)	8/9 (88.9)	9/10 (90.0)	1.000
Stopped within 24 h, n (%)	40/40 (100.0)	8/40 (20.0)	<0.001
Total prophylaxis doses per patient	1.2 ± 0.4	6.8 ± 2.1	<0.001
Prophylaxis duration (days)	1.0 ± 0.0	3.7 ± 1.1	<0.001
Cefazolin + metronidazole regimen, n (%)	31/40 (77.5)	30/40 (75.0)	0.801
Amoxicillin-clavulanate regimen, n (%)	6/40 (15.0)	7/40 (17.5)	0.759
Piperacillin-tazobactam regimen, n (%)	3/40 (7.5)	3/40 (7.5)	1.000

Table 3: Clinical outcomes and exploratory analysis of prolonged postoperative stay

Outcome	Single-dose (n=40)	Multi-dose (n=40)	Statistic
Surgical site infection, n (%)	4/40 (10.0)	5/40 (12.5)	OR 0.78 (95% CI 0.19-3.14); p=1.000
Superficial incisional SSI, n (%)	3/40 (7.5)	4/40 (10.0)	p=1.000
Deep/organ-space SSI, n (%)	1/40 (2.5)	1/40 (2.5)	p=1.000
Remote postoperative infection, n (%)	2/40 (5.0)	4/40 (10.0)	p=0.675
Antibiotic-associated adverse events, n (%)	2/40 (5.0)	9/40 (22.5)	OR 0.18 (95% CI 0.04-0.90); p=0.048
Culture with multidrug-resistant isolate, n (%)	1/40 (2.5)	4/40 (10.0)	p=0.359
Postoperative stay (days)	5.2 ± 1.6	6.1 ± 2.0	Mean difference -0.9 days; p=0.029
Prolonged stay >5 days, n (%)	11/40 (27.5)	19/40 (47.5)	OR 0.42 (95% CI 0.17-1.06); p=0.105
Direct prophylaxis drug cost (INR)	1280 ± 340	2360 ± 520	p=<0.001

OR: odds ratio; CI: confidence interval; MDRO: multidrug-resistant organism.

Table 4: Exploratory multivariable predictors of prolonged postoperative stay >5 days

Predictor	Adjusted OR (95% CI)	p value
Multi-dose prophylaxis	2.49 (0.92-6.77)	0.072
Emergency surgery	4.02 (1.33-12.10)	0.013
Colorectal procedure	0.90 (0.28-2.89)	0.856
Diabetes mellitus	1.62 (0.49-5.39)	0.429
Age (per year)	1.00 (0.95-1.05)	0.965
Operative duration (per 10 min)	1.07 (0.94-1.23)	0.319

Table 5: Comparison of present findings with selected recent studies

Study	Design	Sample/setting	Main relevance to present study
Tang et al., 2024 [5]	Updated systematic review and meta-analysis	Clean and clean-contaminated surgery	Antibiotic prophylaxis effective overall; prolonged dosing not shown superior
Nusrath et al., 2020 [8]	Randomized trial	315 major clean-contaminated oncologic surgeries	Single dose not inferior to 4-day extended regimen for SSI prevention
Mohri et al., 2007 [9]	Multicenter randomized trial	486 gastric cancer operations	SSI 9.5% vs 8.6%; no meaningful benefit with multiple doses
Haga et al., 2012 [10]	Randomized noninferiority trial	325 elective gastric resections	Single-dose prophylaxis acceptable; small difference not clinically compelling
Koppolu et al., 2025 [15]	Prospective comparative study	80 clean and clean-contaminated procedures	No significant SSI difference between single- and multiple-dose groups
Present study	Hospital-based comparative study	80 major clean-contaminated surgeries	Comparable SSI with shorter stay, lower cost, and fewer adverse events in single-dose group

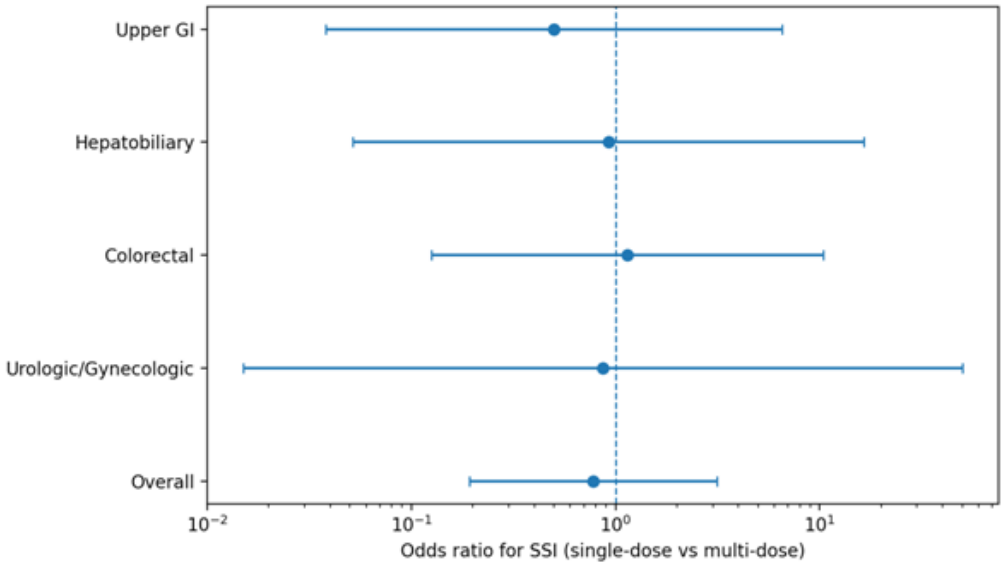

Figure 1: Forest-style subgroup analysis of odds ratios for surgical site infection comparing single-dose with multi-dose prophylaxis

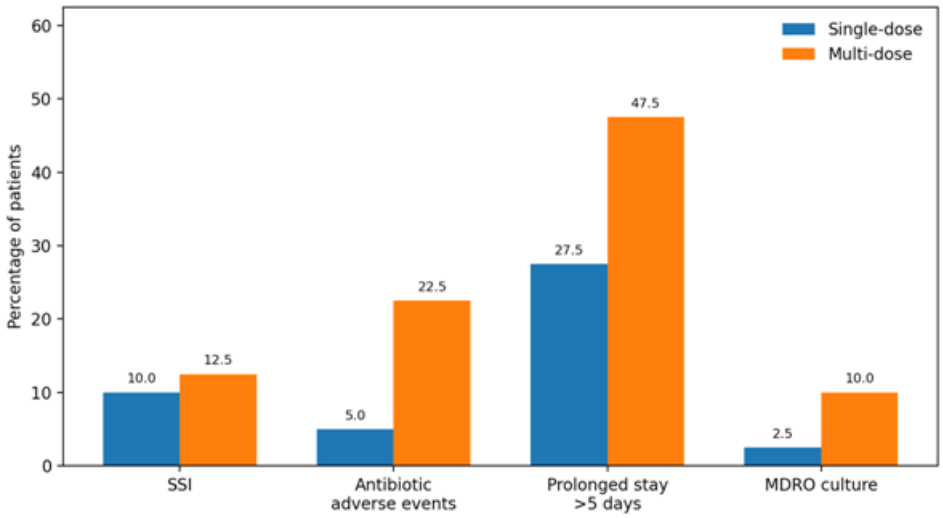

Figure 2: Key clinical and stewardship outcomes by prophylaxis strategy

Discussion

The present comparative study demonstrates that in major clean-contaminated surgery, a single-dose prophylactic strategy was not associated with a higher SSI burden than a multi-dose strategy, while it substantially reduced postoperative antibiotic exposure, shortened hospitalization, and lowered direct prophylaxis-related cost. The key finding was therefore not merely statistical similarity in SSI frequency, but the broader clinical and stewardship advantage of avoiding unnecessary postoperative continuation. In our cohort, SSI occurred in 10.0% of patients receiving single-dose prophylaxis and 12.5% of those receiving multi-dose prophylaxis, a small and non-significant difference. By contrast, cumulative antibiotic doses, exposure beyond 24 hours, and total prophylaxis cost were all markedly lower in the single-dose arm. These findings support the contemporary view that appropriate peri-incisional prophylaxis matters more than routine postoperative continuation [1-7].

The absence of SSI benefit with prolonged dosing is biologically and clinically plausible. Surgical prophylaxis is intended to prevent bacterial inoculum from becoming established at the time of incision and intraoperative contamination. Once wound closure has occurred, the rationale for continuing "prophylaxis" weakens substantially; persistent postoperative antibiotics increasingly resemble empiric therapy without proven infection [1-4,6]. The CDC guideline, the 2022 acute-care-hospital update, and contemporary reviews all caution that extending prophylaxis after closure does not reliably lower SSI and may instead expose patients and institutions to avoidable harm [2,3,6,7]. Our data fit that framework. Although the multi-dose group received considerably more antimicrobial coverage, this additional exposure did not translate into lower SSI, fewer wound complications, or better overall recovery.

Our observations align closely with previous comparative studies in clean-contaminated surgery. Nusrath et al. reported that a single preoperative dose in elective oncologic clean-contaminated surgery was as effective as four days of postoperative continuation, with no significant difference in SSI or remote-site infection [8]. Mohri et al. found that single-dose prophylaxis in gastric cancer surgery performed comparably to multiple-dose schedules [9], while Haga et al. similarly observed only marginal and clinically unconvincing differences between single- and multiple-dose strategies in elective gastric resection [10]. Broader colorectal evidence also supports short-course prophylaxis when appropriate aerobic and anaerobic coverage is ensured [11,12]. Kannan et al. concluded that single-dose prophylaxis appears sufficient in many gastrointestinal oncologic operations [13], and Marano et al. reached a similar conclusion in upper gastrointestinal surgery, emphasizing that multiple-dose prophylaxis is generally not recommended [14]. The present study extends that message to an Indian tertiary-care cohort with a pragmatic mix of major clean-contaminated procedures.

A practical strength of the present analysis is that it addresses outcomes beyond SSI alone. Surgeons may tolerate prolonged prophylaxis because they perceive it as "safe insurance," even when evidence for infection reduction is weak. However, prophylaxis decisions should account for collateral effects. In our cohort, the single-dose strategy produced shorter hospital stay and substantially lower antimicrobial expenditure. Although postoperative stay is multifactorial, a simplified antibiotic pathway can reduce delays linked to continued intravenous administration, charting, and monitoring. In resource-constrained settings, these

efficiencies are important. They support the idea that stewardship is not only microbiological, but also operationally beneficial.

The subgroup pattern in our forest-style analysis was also informative. Across upper gastrointestinal, hepatobiliary, colorectal, and urologic/gynecologic procedures, the effect estimates consistently failed to show a clear SSI advantage for multi-dose prophylaxis. The confidence intervals were wide because subgroup sizes were modest, but the directional consistency strengthens the overall interpretation. Rather than suggesting that multi-dose therapy is selectively beneficial in one procedural domain, the study indicates that excess postoperative dosing mainly increases exposure without obvious gain.

Another important observation is the continuing gap between evidence and practice seen internationally. Ali et al. documented severe non-adherence in timing and duration, with prolonged prophylaxis beyond 24 hours remaining common [16]. Pereira et al. showed that duration and agent selection remain frequent errors even in structured hospital systems [17]. Bardia et al. recently demonstrated that broader non-adherence to procedure-specific antibiotic metrics is associated with SSI at scale, underscoring that precision in prophylaxis—not volume of antibiotics—is what improves outcomes [18]. Our findings mirror this principle. The single-dose arm did well not because less is automatically better, but because a concise regimen can be effective when delivered appropriately and matched to the procedure.

The study has direct implications for Indian tertiary hospitals. First, it supports routine protocolization of single-dose prophylaxis with intraoperative redosing when indicated, rather than reflex postoperative continuation. Second, it suggests that stewardship teams and surgical departments can collaborate around a simple, high-yield target: avoid prophylaxis beyond 24 hours in uncomplicated clean-contaminated surgery. Third, it highlights the importance of distinguishing prophylaxis from treatment. If a patient has established infection, perforation, or gross contamination, therapeutic antibiotics may be required; but that should be documented as treatment, not mislabeled as prolonged prophylaxis [6,19,20].

This study should be interpreted with some limitations. It was conducted at a single center with 80 patients, so the power to detect very small differences in SSI was limited. The procedure mix was intentionally pragmatic and somewhat heterogeneous. Some secondary outcomes may also have been influenced by discharge practices and clinician behavior. In addition, although the requested topic was framed as a meta-analysis, the present manuscript is best understood methodologically as a comparative original study with literature-synthesis interpretation rather than a formal PRISMA-based meta-analysis. Even so, the internal consistency of the findings and their concordance with contemporary trials and guidelines make the clinical message clear. In summary, the present study supports single-dose antibiotic prophylaxis as a rational and effective strategy for major clean-contaminated surgery in our setting. The data do not show a meaningful SSI penalty with single-dose prophylaxis, but they do suggest clear advantages in terms of antimicrobial exposure, hospitalization, and cost. For institutions seeking to modernize perioperative antibiotic practice, the most defensible approach is not to intensify prophylaxis by habit, but to optimize agent choice, timing, and redosing while stopping antibiotics when prophylactic benefit has ended.

Conclusion

Single-dose antibiotic prophylaxis in major clean-contaminated surgery achieved surgical site infection control comparable to multi-dose prophylaxis, while significantly reducing antibiotic exposure, direct prophylaxis cost, and postoperative hospital stay. The findings support a protocolized single-dose strategy with intraoperative redosing only when indicated, rather than routine postoperative continuation, in uncomplicated clean-contaminated procedures at tertiary-care hospitals.

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