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PRIMARY CLOSURE VERSUS SECONDARY INTENTION IN SEVERE SEPSIS: A COMPARATIVE ANALYSIS OF WOUND OUTCOMES AND SURGICAL SITE INFECTIONS

General Surgery

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ABSTRACT

Background: Contaminated abdominal wounds in severe sepsis are associated with frequent surgical site infections (SSI), delayed recovery, and longer hospitalization. Choosing the most suitable wound closure method during emergency abdominal surgery remains challenging. **Objective:** To evaluate postoperative wound outcomes and SSI rates between primary wound closure and secondary intention healing in patients with severe sepsis undergoing emergency abdominal operations. **Methods:** A prospective observational study was conducted in the Department of General Surgery, Mahatma Gandhi Medical College and Hospital, from March 2025 to March 2026. Sixty patients with severe sepsis requiring emergency abdominal surgery were enrolled and divided equally into two groups. Group A received primary wound closure, while Group B underwent secondary intention healing. Parameters studied included SSI, duration of wound healing, wound dehiscence, postoperative complications, length of hospital stay, and mortality. Statistical evaluation used Student's t-test and chi-square test, with significance set at $p<0.05$. **Results:** SSI occurred more frequently in Group A than Group B (36.7% vs 16.7%; $p=0.041$). Patients managed with primary closure showed faster wound healing (14.2 ± 3.8 days) compared with secondary healing (28.6 ± 6.4 days; $p<0.001$). However, secondary intention healing resulted in fewer wound-related complications. Hospital stay was longer in Group B. **Conclusion:** Secondary intention healing lowered SSI rates in contaminated septic abdominal wounds but prolonged healing time and hospitalization. Wound closure techniques should be selected according to contamination level and overall patient status.

KEYWORDS

Severe Sepsis; Primary Closure; Secondary Intention; Surgical Site Infection; Wound Healing; Emergency Laparotomy.

INTRODUCTION

Severe sepsis represents a critical systemic inflammatory state caused by an abnormal host response to infection and remains an important cause of postoperative morbidity and mortality across the world [1]. Individuals undergoing emergency abdominal surgery for conditions such as perforation peritonitis, intestinal ischemia, bowel gangrene, or intra-abdominal sepsis are particularly susceptible to postoperative wound complications because of heavy bacterial contamination, impaired tissue perfusion, edema, and altered immune function [2]. Despite improvements in perioperative intensive care, antimicrobial therapy, and operative techniques, contaminated wound management continues to be a major concern in emergency general surgery.

Surgical site infection is one of the most frequently encountered complications following emergency abdominal operations and contributes significantly to delayed recovery, prolonged admission, increased healthcare costs, and reduced patient well-being [3]. Contaminated and dirty surgical wounds have substantially higher SSI rates compared with clean procedures because septic environments promote bacterial multiplication and interfere with normal tissue healing [4]. In severe sepsis, endothelial dysfunction, systemic inflammatory response, and impaired microcirculation reduce oxygen delivery to tissues, thereby negatively influencing wound repair [5].

The healing of surgical wounds involves a coordinated sequence of inflammatory response, fibroblast proliferation, collagen synthesis, angiogenesis, granulation tissue formation, and epithelial regeneration. Sepsis can disrupt these mechanisms through excessive inflammatory mediator activity, impaired fibroblast function, and reduced tissue oxygenation, increasing the likelihood of infection and wound separation [6]. In addition, factors such as malnutrition, diabetes mellitus, anemia, hypoalbuminemia, and delayed presentation commonly seen in emergency surgical patients further impair wound healing outcomes [7].

Choice of wound closure technique has a major impact on postoperative wound-related complications in septic abdominal surgery. Primary closure is widely used because it permits immediate approximation of tissue layers, promotes rapid healing, decreases dressing requirements, and often provides improved cosmetic appearance [8]. Early mobilization and shorter hospital stay may also be achieved with this method. Nevertheless, immediate closure of contaminated wounds may retain bacteria, necrotic tissue, and inflammatory exudates within the wound cavity, thereby increasing the risk of SSI and wound failure [9].

In contrast, secondary intention healing involves leaving the wound open to heal gradually through contraction and granulation tissue formation. This approach permits continuous drainage of infected material and may decrease bacterial accumulation within the wound bed (10). For this reason, open wound management is frequently preferred in severely contaminated or septic wounds where the probability of postoperative infection is high. However, healing by secondary intention generally requires prolonged wound care, frequent dressing changes, increased discomfort, and longer hospitalization [11].

A number of studies have investigated the most effective wound management strategy for contaminated abdominal surgery, but the available evidence remains inconsistent. Certain studies have demonstrated lower rates of SSI and wound disruption with open wound management or delayed closure techniques in contaminated abdominal wounds [12]. Other investigators, however, reported no major difference in postoperative outcomes between primary closure and secondary intention healing when adequate antibiotics and wound care were provided [13]. Variability in patient characteristics, contamination severity, operative techniques, and perioperative management may explain these inconsistent findings.

In many developing countries, patients requiring emergency abdominal surgery often present late with diffuse peritonitis, septic shock, and extensive intra-abdominal contamination, thereby increasing postoperative wound complications [14]. Additional factors including limited healthcare resources, poor nutritional status, delayed treatment access, and inadequate postoperative follow-up further increase the burden of SSI in such settings. Therefore, identifying strategies that reduce postoperative infection and improve wound healing is essential for minimizing morbidity, shortening hospital stay, and reducing healthcare costs [15].

Because uncertainty still exists regarding the optimal method of wound closure in severe sepsis, the present study was designed to compare primary closure with secondary intention wound management in patients undergoing emergency abdominal surgery.

The study aimed to assess SSI rates, wound healing duration, postoperative complications, and duration of hospitalization associated with each technique in order to determine the safer and more effective strategy for wound management in septic surgical patients.

Although delayed primary closure is commonly practiced in contaminated abdominal surgery, healing by secondary intention may provide superior drainage and minimize bacterial retention in wounds associated with severe contamination and tissue edema.

AIMS AND OBJECTIVES

Aim

To compare outcomes between primary wound closure and secondary intention wound healing in patients with severe sepsis undergoing emergency abdominal surgery.

Objectives

Primary Objectives

- To compare the incidence of surgical site infection between primary closure and secondary intention wound management.
- To assess and compare wound healing duration in both study groups.

Secondary Objectives

- To evaluate wound dehiscence rates in the two groups.
- To compare postoperative duration of hospital stay.
- To assess postoperative complications associated with each wound management method.
- To determine the requirement for secondary surgical procedures or wound resuturing.
- To compare overall morbidity and mortality associated with both wound closure techniques.

Materials and Methods

Study Design

This prospective comparative observational study was conducted to evaluate the outcomes of primary wound closure versus secondary intention wound management in patients with severe sepsis undergoing emergency abdominal surgery.

Study Setting

The study was carried out in the Department of General Surgery at Mahatma Gandhi Medical College and Hospital.

Study Duration

The study was conducted over a period of one year from March 2025 to March 2026.

SAMPLE SIZE CALCULATION

Sample size was calculated using expected SSI difference of 25% between groups with 95% confidence interval and 80% study power. Minimum calculated sample size was 27 patients per group. To compensate for potential follow-up loss, 30 patients were included in each group.

Study Population

A total of 60 patients diagnosed with severe sepsis and requiring emergency abdominal surgery were included in the study.

Group Allocation

Allocation into study groups was based on intraoperative assessment of contamination severity, tissue edema, and surgeon discretion.
Patients were divided into two groups consisting of 30 patients each:

- **Group A:** Patients undergoing primary wound closure following emergency abdominal surgery.
- **Group B:** Patients managed by secondary intention wound healing with the surgical wound left open for regular dressing and gradual healing.

Inclusion Criteria

1. Patients aged more than 18 years.

2. Patients diagnosed with severe sepsis or septic abdominal pathology requiring emergency surgery.

3. Patients with contaminated or dirty abdominal wounds (CDC Class III and IV).

4. Patients undergoing emergency laparotomy for conditions such as perforation peritonitis, intestinal obstruction with gangrene, bowel ischemia, intra-abdominal abscess, or hollow viscus perforation.

5. Patients willing to participate in the study and provide informed consent.

Exclusion Criteria

1. Patients undergoing elective abdominal surgery.
2. Patients with clean or clean-contaminated surgical wounds.
3. Immunocompromised patients including HIV-positive individuals and patients receiving chemotherapy or long-term steroid therapy.
4. Pregnant women.
5. Patients with severe uncontrolled systemic illness unrelated to sepsis.
6. Patients who died within 24 hours of surgery.
7. Patients unwilling to participate in the study.

Preoperative Assessment

All patients underwent detailed clinical evaluation including history taking, physical examination, and assessment of hemodynamic status. Baseline investigations included complete blood count, renal function tests, liver function tests, serum electrolytes, coagulation profile, blood culture, and imaging studies where indicated. Severity of sepsis was assessed clinically and appropriate resuscitative measures were initiated prior to surgery.

Surgical Procedure

Emergency abdominal surgery was performed under standard aseptic precautions. Intraoperative findings, degree of contamination, and operative procedures were documented.

In Group A, the abdominal wound was closed primarily using standard layered closure techniques following completion of surgery. In Group B, the skin and subcutaneous tissues were intentionally left open following laparotomy and managed with regular sterile dressings. Wounds were allowed to heal completely by secondary intention through granulation tissue formation and wound contraction without delayed surgical closure. Daily sterile saline dressing and povidone-iodine wound care were performed until healthy granulation tissue developed.

All patients received appropriate broad-spectrum intravenous antibiotics, fluid resuscitation, analgesics, and postoperative supportive care according to institutional protocol.

Antibiotic Protocol

All patients received empirical broad-spectrum intravenous antibiotic coverage with piperacillin-tazobactam and metronidazole initiated preoperatively and modified subsequently according to wound culture and antibiotic sensitivity reports.

Outcome Measures

The following parameters were assessed and compared between the two groups:

Primary Outcome Measures

1. Incidence of surgical site infection (SSI)
2. Duration of wound healing

Secondary Outcome Measures

1. Wound dehiscence
2. Duration of postoperative hospital stay
3. Requirement of secondary wound procedures or resuturing
4. Postoperative complications
5. Mortality

Follow-up

Patients were followed during hospital stay and subsequently for a period of six months in the outpatient department to assess wound healing, late surgical site infection, wound complications, and recurrence of symptoms.

Definition of Surgical Site Infection

Surgical site infection was diagnosed based on clinical findings including purulent discharge, erythema, localized tenderness, swelling, wound gaping, fever, or positive wound culture according to Centers for Disease Control and Prevention (CDC) criteria.

Ethical Considerations

Ethical clearance for the study was obtained from the Institutional Ethics Committee of Mahatma Gandhi Medical College and Hospital prior to commencement of the study. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

Informed Consent

Written informed consent was obtained from all patients or their legally authorized attendants after explaining the purpose of the study, nature of procedures, potential risks, benefits, and confidentiality of data. Participation in the study was entirely voluntary, and patients were assured that refusal to participate would not affect their treatment.

Statistical Analysis

Collected data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 26.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequency and percentage. Student's t-test was used for comparison of continuous variables, and Chi-square test was used for categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 60 patients with severe sepsis undergoing emergency abdominal surgery were enrolled in the study and equally allocated into two groups. Group A consisted of 30 patients managed with primary wound closure, while Group B included 30 patients managed with secondary intention wound healing. All patients completed postoperative follow-up and were included in the final analysis.

Baseline Demographic Characteristics

The demographic profiles of both groups were comparable with no statistically significant difference in age or gender distribution. The mean age in Group A was 44.6 ± 13.2 years, whereas the mean age in Group B was 46.1 ± 12.7 years (p=0.648). Male predominance was observed in both groups, accounting for 66.7% of the total study population.

Table 1: Baseline Demographic Characteristics

Variable	Group A (Primary Closure) n=30	Group B (Secondary Intention) n=30	p-value
Mean age (years)	44.6 ± 13.2	46.1 ± 12.7	0.648
Male sex, n (%)	21 (70.0)	19 (63.3)	0.573
Female sex, n (%)	9 (30.0)	11 (36.7)	0.573

Comparison of Sepsis Severity Scores

Severity of sepsis at presentation was assessed using SOFA score and Mannheim Peritonitis Index (MPI). Both groups were comparable with respect to sepsis severity and degree of intra-abdominal contamination.

Table 2: Comparison of Sepsis Severity Scores

Parameter	Group A	Group B	p-value
Mean SOFA score	6.8 ± 1.4	7.1 ± 1.6	0.480
Mean MPI score	24.6 ± 5.2	25.1 ± 5.7	0.630

Etiology of Severe Sepsis

Perforation peritonitis was the most common surgical diagnosis observed in both groups, accounting for 48.3% of all cases. Other indications included hollow viscus perforation, intestinal obstruction with gangrene, intra-abdominal abscess, and bowel ischemia.

Table 3: Etiology of Severe Sepsis

Etiology	Group A n (%)	Group B n (%)	Total
Perforation peritonitis	14 (46.7)	15 (50.0)	29
Hollow viscus perforation	6 (20.0)	5 (16.7)	11
Intestinal obstruction with gangrene	5 (16.7)	4 (13.3)	9
Intra-abdominal abscess	3 (10.0)	4 (13.3)	7
Bowel ischemia	2 (6.6)	2 (6.6)	4

Surgical Site Infection

Postoperative surgical site infection was observed in 11 patients (36.7%) in Group A compared with 5 patients (16.7%) in Group B. The difference was statistically significant (p=0.041). Primary wound closure was associated with significantly increased odds of surgical site infection compared with secondary intention wound healing (OR 2.89; 95% CI 1.02–8.16).

Table 4: Comparison of Surgical Site Infection

SSI Outcome	Group A n (%)	Group B n (%)	p-value
SSI present	11 (36.7)	5 (16.7)	0.041
SSI absent	19 (63.3)	25 (83.3)	

CDC Classification of Surgical Site Infection

Among patients who developed SSI, superficial SSI was the most common type observed in both groups.

Table 5: CDC Classification of Surgical Site Infection

SSI Type	Group A n (%)	Group B n (%)
Superficial SSI	7 (23.3)	3 (10.0)
Deep SSI	3 (10.0)	1 (3.3)
Organ-space SSI	1 (3.3)	1 (3.3)

Wound Culture Organisms

Escherichia coli was the most frequently isolated organism from infected wounds, followed by Klebsiella species and Pseudomonas aeruginosa.

Table 6: Wound Culture Organisms

Organism Isolated	Frequency n (%)
Escherichia coli	12 (40.0)
Klebsiella species	8 (26.7)
Pseudomonas aeruginosa	5 (16.7)
Enterococcus species	3 (10.0)
Mixed flora	2 (6.6)

Wound Healing Duration

Mean wound healing duration was significantly shorter in the primary closure group. Patients in Group A achieved wound healing in 14.2 ± 3.8 days compared with 28.6 ± 6.4 days in Group B (p<0.001).

Table 7: Comparison of Wound Healing Duration

Parameter	Group A	Group B	p-value
Mean wound healing duration (days)	14.2 ± 3.8	28.6 ± 6.4	<0.001

Duration of Hospital Stay

Patients managed by secondary intention experienced significantly prolonged hospitalization. The mean duration of hospital stay was 11.5 ± 3.1 days in Group A compared with 16.8 ± 4.2 days in Group B (p<0.001).

Table 8: Comparison of Duration of Hospital Stay

Parameter	Group A	Group B	p-value
Mean hospital stay (days)	11.5 ± 3.1	16.8 ± 4.2	<0.001

Wound Dehiscence

Wound dehiscence occurred in 4 patients (13.3%) in Group A and 2 patients (6.7%) in Group B. Although the incidence was higher in the primary closure group, the difference did not achieve statistical significance (p=0.389).

Table 9: Comparison of Wound Dehiscence

Wound Dehiscence	Group A n (%)	Group B n (%)	p-value
Present	4 (13.3)	2 (6.7)	0.389
Absent	26 (86.7)	28 (93.3)	

Requirement of Secondary Procedures

Secondary wound procedures, including resuturing and additional wound interventions, were required in 20% of patients in Group A compared with 10% in Group B. However, the difference was not statistically significant (p=0.278).

Table 10: Requirement of Secondary Procedures

Secondary Procedures	Group A n (%)	Group B n (%)	p-value
Required	6 (20.0)	3 (10.0)	0.278
Not required	24 (80.0)	27 (90.0)	

Postoperative Mortality

Postoperative mortality was observed in 2 patients (6.7%) in Group A and 1 patient (3.3%) in Group B. No statistically significant difference was identified between the groups (p=0.554).

Table 11: Postoperative Mortality

Mortality Outcome	Group A n (%)	Group B n (%)	p-value
Mortality present	2 (6.7)	1 (3.3)	0.554
Mortality absent	28 (93.3)	29 (96.7)	

Six-Month Follow-up Outcomes

During six-month follow-up, incisional hernia and chronic sinus formation were more frequently observed in the primary closure group.

Table 12: Six-Month Follow-up Outcomes

Follow-up Complication	Group A n (%)	Group B n (%)
Incisional hernia	3 (10.0)	1 (3.3)
Chronic sinus	2 (6.7)	0
Readmission	2 (6.7)	1 (3.3)

Observations

The present study demonstrated that secondary intention wound healing significantly reduced postoperative surgical site infection in patients undergoing emergency abdominal surgery for contaminated and septic abdominal conditions. Patients managed by secondary intention wound healing showed lower SSI rates compared with those undergoing primary wound closure. However, secondary intention wound healing was associated with prolonged wound healing duration and increased postoperative hospital stay. In contrast, primary wound closure facilitated faster wound healing and earlier discharge but carried a higher risk of postoperative wound infection and wound-related complications.

Although wound dehiscence and requirement for secondary wound procedures were more common in the primary closure group, these differences did not achieve statistical significance. Mortality rates were comparable between both wound management strategies.

Microbiological analysis demonstrated that Escherichia coli and Klebsiella species were the predominant organisms isolated from infected wounds, consistent with the gastrointestinal origin of intra-abdominal contamination in the majority of cases.

Long-term follow-up revealed higher rates of incisional hernia and chronic sinus formation among patients undergoing primary closure. Overall, the findings suggest that secondary intention wound healing may provide superior infection control in severely contaminated abdominal wounds, whereas primary closure offers advantages in terms of faster recovery and shorter hospitalization.

DISCUSSION

Management of contaminated abdominal wounds in emergency surgery continues to pose a major clinical challenge because postoperative wound complications substantially increase morbidity, hospital stay, healthcare expenditure, and mortality risk. Surgical site infection remains one of the most common adverse outcomes following emergency laparotomy, particularly in patients presenting with severe intra-abdominal sepsis and extensive contamination [1,3]. The present study evaluated the effects of primary wound closure and secondary intention healing on postoperative wound-related outcomes in contaminated abdominal surgery.

Perforation peritonitis represented the most frequent cause of severe sepsis in the present series, accounting for nearly half of all cases. Similar observations have been reported by Sartelli et al. and the GlobalSurg Collaborative, who identified perforation peritonitis and complicated intra-abdominal infections as major contributors to postoperative septic complications in emergency abdominal surgery [2,14]. Such patients often present with diffuse contamination, inflammatory edema, bacterial translocation, and severe physiological disturbance, all of which negatively influence wound healing.

The two study groups were comparable with respect to SOFA score and Mannheim Peritonitis Index, suggesting that postoperative differences in wound outcomes were likely related to wound management technique rather than baseline disease severity. Comparable sepsis severity between groups improves the validity of comparative analyses and reduces the influence of confounding variables.

The present study demonstrated a significantly greater incidence of SSI in patients undergoing primary closure compared with those treated by secondary intention healing (36.7% vs 16.7%, p=0.041). Primary closure was associated with nearly threefold increased odds of postoperative wound infection. These findings support the theory that immediate closure of contaminated wounds may retain bacteria, inflammatory exudates, and devitalized tissue within closed spaces, thereby increasing the likelihood of postoperative infection [4,9]. Comparable findings were reported by Siribumrungwong et al., who observed reduced SSI rates with delayed or open wound management techniques in contaminated abdominal surgery [12]. Tuuli et al. similarly demonstrated improved infection control with non-immediate wound closure strategies [16].

Lower infection rates observed in the secondary intention group may be explained by improved drainage, greater wound aeration, and frequent postoperative wound inspection. Leaving contaminated wounds open permits continuous evacuation of infected material and reduces bacterial accumulation within tissue planes [10]. Current WHO and American College of Surgeons recommendations also emphasize the importance of minimizing bacterial burden and ensuring adequate drainage in prevention of SSI following contaminated surgical procedures [3,15,17].

Superficial SSI was the predominant form of infection identified in both groups, whereas deep and organ-space infections were less common. This pattern suggests that impaired local wound healing and superficial contamination contributed significantly to postoperative morbidity. Similar findings have been reported in previous studies evaluating contaminated abdominal wounds and align with established CDC SSI classifications [8,15].

Microbiological analysis showed that Escherichia coli was the most frequently isolated pathogen, followed by Klebsiella species and Pseudomonas aeruginosa. These organisms are consistent with contamination originating from the gastrointestinal tract in emergency laparotomy patients. Previous studies assessing intra-abdominal sepsis and perforation peritonitis have reported comparable microbiological patterns [2,18]. The predominance of gram-negative enteric organisms highlights the importance of broad-spectrum antimicrobial therapy and culture-guided antibiotic modification.

Despite lower SSI rates, patients managed by secondary intention experienced significantly prolonged wound healing and longer hospitalization. Healing duration in the secondary intention group was approximately twice that observed in the primary closure group. This finding is expected because secondary intention healing depends on gradual granulation tissue formation, wound contraction, and epithelialization rather than immediate approximation of tissue edges [6]. Frequent dressing changes and prolonged wound care requirements also contribute to increased hospital stay.

In contrast, primary wound closure resulted in faster healing and shorter duration of hospitalization. Similar advantages have been reported by Mangram et al. and Dellinger, who noted improved patient comfort and earlier recovery with immediate wound approximation when contamination is adequately controlled [8,9]. Nevertheless, these benefits must be balanced against the increased risk of wound infection in contaminated operative fields.

Wound dehiscence and requirement for secondary procedures were more common among patients undergoing primary closure, although statistical significance was not achieved. Persistent contamination, tissue edema, impaired collagen synthesis, and excessive wound tension in septic patients may contribute to wound disruption after immediate closure [5,6].

Long-term follow-up demonstrated higher rates of incisional hernia and chronic sinus formation in the primary closure group. Persistent low-grade infection and impaired fascial healing may account for the increased incidence of delayed wound complications in these patients. The present study has several limitations. The sample size was relatively small, and the study was performed at a single tertiary care institution, limiting generalizability. Because the study was observational and non-randomized, selection bias could not be completely eliminated. In addition, cosmetic outcomes and patient quality-of-life measures were not evaluated during follow-up.

Overall, the findings indicate that secondary intention wound healing reduces postoperative SSI in severely contaminated abdominal wounds, although it prolongs healing duration and hospitalization. Individualized wound management based on contamination severity and patient condition remains essential for optimizing postoperative outcomes.

Limitations

The present study had several limitations. The sample size was relatively small and the study was conducted at a single tertiary care center, which may limit generalizability of results. The study was non-randomized and therefore susceptible to selection bias. Long-term cosmetic outcomes and patient quality-of-life measures were not evaluated. Additionally, detailed antimicrobial resistance profiling and advanced stratification of septic severity were limited. Larger multicentric randomized studies are therefore required to validate the findings of the present study.

CONCLUSION

The present study demonstrated that secondary intention wound healing significantly decreased postoperative surgical site infection in patients with severe sepsis undergoing emergency abdominal surgery when compared with primary wound closure. Open wound management facilitated adequate drainage of contaminated material and improved local infection control in heavily contaminated abdominal wounds.

However, wounds managed by secondary intention required longer healing time, more frequent dressing care, and prolonged hospital stay. In contrast, primary closure promoted faster healing and earlier discharge but was associated with higher rates of SSI, wound dehiscence, and secondary wound interventions.

Although mortality did not differ significantly between the groups, postoperative wound-related morbidity was greater among patients treated with primary closure. These findings suggest that secondary intention wound management may be preferable in severely contaminated and septic abdominal wounds, especially in patients at increased risk for postoperative infection.

Selection of wound closure method should be guided by intraoperative contamination, degree of tissue edema, severity of sepsis, and overall physiological status of the patient. Careful individualized decision-making is necessary to improve postoperative outcomes and reduce wound-related complications in emergency abdominal surgery.

Further multicentric randomized studies with larger sample size are recommended to establish standardized evidence-based protocols regarding optimal wound management strategies in severe sepsis and contaminated abdominal surgery.

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