ORIGINAL ARTICLE

Comparison of Incidence of Superficial Surgical Site Infection in Primary Closure over Drain versus Delayed Primary Closure in Patients Undergoing Exploratory Laparotomy for Peritonitis

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ABSTRACT

Objective: To document difference in incidence of superficial surgical site infection (SSSI) following primary wound closure over a drain versus delayed wound closure after exploratory laparotomy for generalized peritonitis.

Methodology: A prospective cross-sectional observational study was carried out at Surgical Unit-II, Services Hospital, Lahore, from January 2016 to December 2020. Patients between the ages of 12 and 65 years who had presented in the surgical emergency with peritonitis requiring exploratory laparotomy were enrolled. Approval from Institutional Review Board and written informed consent from all the patients were obtained. Midline laparotomy was made in all cases. In group A, primary closure of wound over a corrugated rubber drain (CRD) was done. In group B, each patient's wound was left open for twice a day dressing with saline-soaked gauze with delayed closure on 5th post-operative day. After surgery, patients were shifted to ward and were followed-up there for seven days. Then patients were discharged and were followed up in OPD weekly up to the 30th day after surgery. Wounds were examined at follow up for SSSI. The data was entered and analyzed through SPSS version 20. Comparison of frequency of SSI in both groups by using chi-square test was done using p-value =0.05 as significant.

Results: Mean age of the participants was 35.51±14.11 years with 118 (60.20%) males and 78 (39.80%) females. Total of 23 (11.73%) patients had SSI and 173 (88.26%) patients had no SSI. No statistical difference of SSSI was seen between both groups.

Conclusion: No significant difference was found in the incidence of SSSIs between primary closure over a drain and delayed wound closure following exploratory laparotomy for generalized peritonitis.

Keywords: Delayed primary closure, drain, primary closure, superficial surgical site infection

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INTRODUCTION

Wound infection is the invasion of infective organisms through body tissue after breakdown in local and systemic host defenses. Infection at surgical site within 30 days of surgery is surgical site infection (SSI) and is a common post-operative complication. It results in additional interventions, prolonged stay in hospital, increased cost, increased morbidity and mortality.[1] The CDC has reported approximately 110,800 SSIs in the year 2015.[2] SSI constitutes 20% of all hospital acquired infections and increased mortality risk by 2 to 11 fold.

The annual cost of SSI is estimated to be 3.3$ billion annually. On average, the length of hospital stay is increased by almost 10 days due to SSI per patient.[3-5] The CDC has developed a system for surgical wound classification with the aim to identify patients with surgical wounds that are at risk to develop SSI. It classified surgical wounds into four types: clean as type 1; clean/ contaminated as type II; contaminated as type III; and dirty as type IV. It has been noted that the incidence of deep and superficial surgical site infection increases with type 3 and type 4.[6]

Exploratory laparotomy for perforation is one of the common cases faced by surgeons in the Emergency. Post-surgery infection after such cases is expected.[7] Various techniques are used to mitigate these. Thorough intra-peritoneal lavage, antibiotics, and intra-abdominal drain placement are some of the methods to reduce deep surgical site infections. While multiple techniques are adopted by surgeons for skin wound closure to prevent superficial surgical site infections in such cases. One of the most commonly used ways is to delay the closure of wounds in patients with dirty or contaminated wounds. Some studies demonstrate that while delayed primary skin closure is simple and cheap way to reduce the incidence of SSI, the literature so far has failed to provide significant evidence to support this view.[8] Historically, delayed primary closure was used to reduce SSI risk especially in contaminated cases. This allows a closed wound while reducing morbidity. But similar results have not been obtained by all researchers.[9]

There are only limited studies done from our part of the world on this subject. We, therefore, attempted to document the differences in frequency of superficial surgical site infection (SSSI) with primary wound closure over a drain versus delayed wound closure after exploratory laparotomy for generalized peritonitis. The rationale for conducting this study stems from the need to address the high incidence of SSSIs following exploratory laparotomy for perforation, particularly in patients with generalized peritonitis. While various techniques are employed to reduce the risk of infection, including thorough lavage, antibiotics, and drain placement, the optimal approach for skin wound closure remains a topic of debate. Delayed primary closure is widely used in contaminated wounds, but existing evidence regarding its effectiveness in reducing SSSI is inconclusive, with limited data from our region. By comparing the rates of SSSI in patients with primary versus delayed wound closure, this study seeks to provide valuable local data that could guide clinical practice and improve postoperative outcomes for patients undergoing emergency laparotomy.

METHODOLOGY

IRB/ERC Approval:

A prospective cross-sectional observational study was carried out at Surgical Unit-II, Services Hospital, Lahore, from January 2016 to December 2020 after approval by the Institutional Review Board Ref No. IRB/2015/167/SIMS.

We had a sample size of 196 cases; 98 cases in each group was calculated with 95% power of test, 5% level of significance and taking expected percentage of SSI i.e. 23.5% with delayed closure and 5.6% with primary wound closure over a drain after exploratory laparotomy for generalized peritonitis.[8] Patients between the ages of 12-65 years who had presented in the surgical emergency with peritonitis requiring exploration were included in the study. The diagnosis was based on clinical assessment and radiological workup. All patients were examined by consultants in the Emergency prior to decision for exploration. After obtaining written informed consent, the patients were allocated into two groups by using a computer-generated randomization table.

Pre-operative resuscitation was done in all cases. All patients were started on intravenous antibiotics and fluids which were also continued post-operatively. Surgery was performed under supervision of emergency consultant in the Emergency department. Midline laparotomy was made in all cases. After management of intra-abdominal pathology, thorough peritoneal lavage was done. Drains were placed intra-abdominally. No. 1 polypropylene was used to close the abdominal fascia (linea alba). In group A, primary closure of wound over a corrugated rubber drain (CRD) was done. Dressing was done which was changed daily in the ward. In group B, patients' wounds were left open for delayed closure on fifth post-operative day. The same surgical team performed all surgeries. After surgery, patients were shifted to ward. Daily wound evaluation was done for seven days. Then patients were discharged and were followed-up in OPD weekly up to the 30th day after surgery. Wounds were examined at follow-up. SSSI was labelled as positive if infection occurred within 30 days of surgery. The following criteria was used to define infection: presence of >1 of the following: fever (>99 F for 24 hours), pain or redness at wound site, localized swelling, or purulent discharge (pus) from wound. The patients, who developed SSSI, were managed as per hospital protocol.

All data was entered into SPSS version 20 and analyzed. Mean and standard deviation were calculated for numerical variables such as age. Frequency and percentage were generated for qualitative variables such as gender and SSSI. Affected modifiers were controlled through stratification and to compare frequency of SSSI in both groups, Chi-Square test was employed using p-value=0.05 as significant. Stratification of data was done to address the effect modifiers.

RESULTS

We enrolled 196 patients in this prospective cross-sectional observational study. Computer generated randomization sequence was used to divide the patients into two equal groups. Mean age of the participants was 35.51±14.11 years with 118 (60.20%) male and 78 (39.80%) females. Mean ages of the patients in both groups were similar as shown in Table 1 and more than half of the patients were male in both groups. Total of 23 (11.73%) patients had SSSI and 173 (88.26%) patients had no SSI. When comparison of the two groups was done, no significant difference in SSSI was found in both groups as shown in Table 2. Stratification of surgical site infection (SSI) in both groups with respect to age and gender is shown in Table 3.

Table 1: Patient age and gender distribution in both groups

Group Assigned	Mean Age (years)	Male	Female
Group A: Primary Closure	33.42 ± 12.37	64 (65.30%)	34 (34.69%)
Group B: Delayed Closure	37.60 ± 15.48	54 (55.10%)	44 (44.89%)

*= significant p value=0.05

Table 2: Comparison of Superficial Surgical Site Infection (SSSI) according to group assigned

Group Assigned	SSSI		p-value
	Yes	No	
Group A: Primary Closure	10 (10.2%)	88 (89.79%)	0.57
Group B: Delayed Closure	13 (13.26%)	85 (86.73%)	

*= significant p value=0.05

Table 3: Stratification of Superficial Surgical Site Infection (SSSI)

Clinical variables	Group Assigned	SSSI		p-value
		Yes	No	
Age = 40 years	Primary Closure	2	72	1.00
	Delayed Closure	2	61	
Age > 40 years	Primary Closure	8	18	1.00
	Delayed Closure	11	22	
Male gender	Primary Closure	3	61	0.1372
	Delayed Closure	7	46	
Female gender	Primary Closure	6	28	0.5163
	Delayed Closure	4	40	

*= significant p value=0.05

DISCUSSION

Our study showed no statistical difference in frequency of superficial surgical site infection (SSSI) among peritonitis patients undergoing primary wound closure versus delayed closure following exploratory laparotomy. Surgical site infection has been documented for hundreds of years.[10] It is also associated with increased morbidity of the patients. There is an immense interest in finding methods to reduce the surgical site infections. Different surgical techniques were also employed to counter this problem.[11] Wound in patients after peritonitis are classified as “dirty” class IV. These wounds have been documented to have a higher rate of complications. DPC was initially used for the management of soft tissue injuries during trauma and later was adopted elsewhere. Prospective studies have yielded variable results. Few studies reported similar SSSI rates when comparing primary and delayed primary closure where as other studies have shown that Delayed Primary Closure to have a lower wound SSSI rate than primary closure.[12,13] A multicenter randomized trial from Thailand showed no statistical differences of SSSI rates in the two groups but it was lower in primary closure approach.[14] A randomized control trail done in India showed that delayed primary closure resulted in decreased superficial surgical site infections although this did not lead to a shorter hospital stay.[15]

When we review the different meta-analysis, mixed results are seen again found no difference when comparing SSSI between primary and delayed primary closure[16,17]. Tang suggested that delayed primary closure may have a better outcome but there was no significant evidence. Similar findings were also noted by Tang in his meta-analysis.[18] Siribumrungwong et al.[14] found no difference in the outcomes of the two groups while Henry and Moss determined primary closure to be more effective as opposed to delayed primary closure. In our study, out of 196 patients randomized into two groups, primary closure of the wound over a drain and delayed wound closure, only 23 patients (11.73%) developed superficial surgical site infections (SSSI). This finding suggests a relatively low incidence of SSSI across both groups, warranting further analysis of the differences between the two closure techniques in terms of infection rates and other postoperative outcomes.

Our is a large sample size study but we found no statistically significant difference between either technique although infection rate was less in the primary closure over CRD as opposed to delayed closure group. Furthermore, we focused only on infection rate, and other parameters, such as hospital stay length and

patient preference, may also be considered. In our view, primary closure over a drain is an efficient way to close the abdominal wound at the primary surgery since, although there is no difference in outcome between the two methods, primary closure over CRD avoids a second intervention and allows the patient to be more comfortable as the wound is closed at the time of the primary surgery. From Lahore, Ghous et al.[19] reported SSIs in 13.5% patients undergoing emergency abdominal surgeries, with staphylococcus aureus being the most common pathogen. Khan et al.[20] reported SSIs in 12.6% patients undergoing exploratory laparatomy while pseudomonas aeruginosa being the most frequent cause.

One limitation of our study is the potential influence of **bacterial contamination** on the development of SSSI. While bacterial cultures were not uniformly available for all patients, those obtained during surgery could provide insight into the microbial environment and its impact on infection rates. The presence of certain pathogens, particularly those from bowel content or other infected intra-abdominal sources, may have influenced the occurrence of SSSIs independently of the wound closure technique used. Therefore, variations in bacterial growth and the pathogenicity of the organisms cultured could represent a confounding factor that may not have been fully accounted for in our analysis. This could have affected the over all infection rates in both groups, potentially skewing the results and limiting the generalizability of our findings. Furthermore, it is important to note that **ICU admission** and other postoperative complications were not part of the scope of this study, and future research could benefit from investigating the impact of different wound closure techniques on the need for intensive care and over all recovery outcomes. Other limitations of our study include its **single-center design**, which may limit the generalizability of the findings to broader populations, as well as the **lack of blinding** in patient allocation, which could introduce bias in outcome assessment. Additionally, the study did not control for **patient co-morbidities** such as diabetes mellitus or immunosuppression, which may have contributed to variations in infection rates. Finally, the relatively **short follow-up period** may not capture late-onset infections or complications that could influence long-term outcomes.

CONCLUSION

In conclusion, our study found no significant difference in the incidence of SSSIs between primary closure over a drain and delayed wound closure following exploratory laparotomy for generalized peritonitis, suggesting that both techniques may be equally effective in preventing SSIs in this patient population. This suggests that neither technique provided a significant advantage in reducing the incidence of SSIs, indicating that other factors, such as bacterial contamination, patient co-morbidities, and intraoperative conditions, may play a more critical role in infection outcomes. We recommend that both primary closure over a drain and delayed wound closure be considered viable options for wound management after exploratory laparotomy for generalized peritonitis; however, further multicenter, randomized controlled trials with larger sample sizes and longer follow-up periods are needed to better understand the long-term outcomes and the role of bacterial contamination in infection rates.

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REFERENCES

1. Zabaglo M, Leslie SW, Sharman T. Postoperative Wound Infections. 2024 Mar 5. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2024 Jan–. PMID: 32809368.
2. Magill SS, O'Leary E, Janelle SJ. Changes in Prevalence of Health Care-Associated Infection in U.S. Hospitals. N Engl J Med. 2018;379(18): 1732-44.
3. Ban KA, Minei JP, Laronga C, Harbrecht BG, Jensen EH, Fry DE, et al. American College of Surgeons and Surgical Infection Society: Surgical Site Infection Guidelines, 2016 Update. J Am Coll Surg. 2017; 224(1): 59-74. doi: 10.1016/j.jamcollsurg.2016.10.029.
4. Singh RK, Gurana KR. Readmissions Following Pancreaticoduodenectomy: Experience From a Tertiary Care Center in India. Cureus. 2024;16(7):e65140. doi: 10.7759/cureus.65140.
5. Yang L, Yi F, Xiong Z, Yang H, Zeng Y. Effect of preoperative hospital stay on surgical site infection in Chinese cranial neurosurgery. BMC Neurol. 2023;23(1): 407. doi: 10.1186/s12883-023-03431-z.
6. Onyekwelu I, Yakkanti R, Protzer L, Pinkston CM, Tucker C, Seligson D. Surgical Wound Classification and Surgical Site Infections in the Orthopaedic Patient. J Am Acad Orthop Surg Glob Res Rev. 2017;1(3):e022. doi: 10.5435/JAAOSGlobal-D-17-00022.

7. Gejoe G, Yadev I, Rahul M. Emergency Laparotomies at a Tertiary Care Center-a Hospital-Based Cross-Sectional Study. Indian J Surg. 2017;79(3):206-211. doi: 10.1007/s12262-016-1446-5.

8. Kadota Y, Nishida K, Hashizume K, Nasu Y, Nakahara R, Kanazawa T, et al. Risk factors for surgical site infection and delayed wound healing after orthopedic surgery in rheumatoid arthritis patients. Mod Rheumatol. 2016;26(1):68-74. doi: 10.3109/14397595.2015.1073133

9. Andrade EG, Guerra JJ, Punch L. A Multi-Modal Approach to Closing Exploratory Laparotomies Including High-Risk Wounds. Cureus. 2020;12(7):e9087. doi: 10.7759/cureus.9087

10. Sherwood D, Dovgan J, Schirmer D, Haring RS, Schneider B. The association between preoperative epidural steroid injections and postoperative cervical and lumbar surgical site infections: A systematic review and meta-analysis. N Am Spine Soc J. 2024;19:100334. doi: 10.1016/j.xnsj.2024.100334.

11. Chauveaux D. Preventing surgical-site infections: measures other than antibiotics. Orthop Traumatol Surg Res. 2015;101(1 Suppl):S77-83. doi: 10.1016/j.otsr.2014.07.028

12. Madariaga MC, O'Malley NA, Groff H, Alben M, Papalia A, Fogel J, Thompson J, et al. Does hydrogen peroxide help mitigate the incidence ofCutibacterium acnesin cervical spine surgeries? N Am Spine Soc J. 2024;19:100514. doi: 10.1016/j.xnsj.2024.100514.

13. Gomez DA, Mazarei M, Abdulwadood I, Casey WJ 3rd, Rebecca AM, Reece EM. Wound closure techniques for spinoplastic surgery: a review of the literature. Neurosurg Rev. 2024;47(1):460. doi: 10.1007/s10143-024-02704-6.

14. Siribumrungwong B, Chantip A, Noorit P, Wilasrusmee C, Ungpinitpong W, Chotiya P, et al. Comparison of Superficial Surgical Site Infection Between Delayed Primary Versus Primary Wound Closure in Complicated Appendicitis: A Randomized Controlled Trial. Ann Surg. 2018;267(4):631-637. doi: 10.1097/SLA.0000000000002464.

15. Baksi A, Chatterjee S, Ray U, Nilima N, Firoz Khan W, Banerjee N. A randomized trial analyzing the effects of primary versus delayed primary closure of incision on wound healing in patients with hollow viscus perforation. Turk J Surg. 2020;36(4):327-332. doi: 10.47717/turkjsurg.2020.4882.

16. Van Der Merwe Z, Wilton SD, Sandy-Hodgetts K. Risk factors associated with surgical site infection following orthopaedic surgery in South Africa and Sub-Saharan Africa: a scoping review protocol. J Wound Care. 2024;33(Sup8):S4-S8. doi: 10.12968/jowc.2024.0102.

17. Ali A, Abdullah M, Shiraz MI, Amir MA, Shahid AR, Naseer BB, et al. The efficacy of wound edge protectors in reducing surgical site infections in gastrointestinal surgeries: An updated systematic review and meta-analysis. Curr Probl Surg. 2024;61(9):101552. doi: 10.1016/j.cpsurg.2024.101552.

18. Tang S, Hu W, Hu L, Zhou J. Primary Versus Delayed Primary Incision Closure in Contaminated Abdominal Surgery: AMeta-Analysis. J Surg Res. 2019;239:22-30. doi: 10.1016/j.jss.2019.01.047.

19. Ghous F, Sarwar M, Faisal MS. Frequency of surgical site infection after emergency abdominal surgeries: an audit of 200 cases at a tertiary care unit. Proceedings S.Z.P.G.M.I. 2018;32(1):29-34.

20. Khan FU, Fang Y, Khan Z, Khan FU, Iqbal Malik Z, Ahmed N, et al. Occurrence, associated risk factors, and treatment of surgical site infections in Pakistan. Eur J Inflamm. 2020;18:2058739220960547. doi:10.1177/2058739220960547.