Original Article
DOI: https://doi.org/10.70749/ijbr.v3i6.3064

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://ijbr.com.pk
ISSN: 2960-2793/ 2960-2807

Frequency and Risk Factors of Wound Dehiscence in Patients Undergoing Emergency Midline Laparotomy at Tertiary Care Hospital, Karachi

Aneela Bibi[1], Daniyal Mehboob[2], Jabeen Zehra[3], Cheena Kumari[4], Surrendar Dawani[5]

[1,3,5]Department of General Surgery, Jinnah Postgraduate Medical Centre, Karachi, Sindh, Pakistan.
[2]Trust Grade Doctor, General Surgery, National Health Services, UK
[4]Department of Pediatric Surgery, Dow University of Health Sciences / Civil Hospital, Karachi, Sindh, Pakistan.

ARTICLE INFO

Keywords: Wound Dehiscence; Emergency Laparotomy; Midline Incision; Postoperative Complications; Surgical Site Infection; Risk Factors; Abdominal Surgery; ASA Classification.

Correspondence to: Aneela Bibi, Department of General Surgery, Jinnah Postgraduate Medical Centre, Karachi, Pakistan.
Email: aneelanazarbaloch@gmail.com

Declaration
Authors' Contribution
All authors equally contributed to the study and approved the final manuscript

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History
Received: 06-06-2025 Revised: 12-06-2025
Accepted: 18-06-2025 Published: 28-06-2025

ABSTRACT

Background: Wound dehiscence remains a significant postoperative challenge, particularly following emergency abdominal surgery, where time for preoperative optimization is limited. This study assessed the frequency of wound dehiscence and explored potential contributing factors in patients undergoing emergency midline laparotomy at a tertiary care hospital in Karachi. **Methods:** We carried out a cross-sectional study over a period of three month from 1st March 2025 to 31 May 2025 in the Department of Surgery at Jinnah Postgraduate Medical Centre (JPMC), Karachi, using non-probability consecutive sampling. We enrolled 175 patients aged 30 to 80 years who underwent emergency midline laparotomy and had an ASA physical status of I or II. We excluded patients with major comorbidities, malignancies, re-operations, or gynecological procedures. We recorded demographic, clinical, and intraoperative variables and assessed the occurrence of wound dehiscence. Associations between these variables and wound dehiscence were analyzed using chi-square tests. **Results:** Among 175 patients, 10 (5.7%) developed wound dehiscence. We found no statistically significant association between wound dehiscence and any of the measured variables, including age, sex, ASA classification, duration of surgery, anemia, smoking status, obesity, wound infection, or postoperative ileus ($p > 0.05$ across all variables). **Conclusion:** Wound dehiscence occurred in a small proportion of patients undergoing emergency midline laparotomy, and no single demographic or perioperative factor appeared to predict its occurrence. These findings reinforce the multifactorial nature of wound dehiscence and highlight the need for comprehensive perioperative management. Larger prospective studies incorporating nutritional and biochemical markers may help identify at-risk patients more accurately and inform preventive strategies.

INTRODUCTION

Wound dehiscence, also known as burst abdomen, is a severe postoperative complication linked to significant morbidity and mortality. It poses multiple challenges: for patients, it leads to increased physical and emotional suffering and a heightened risk of death; for caregivers and families, it results in greater financial burdens due to extended treatment requirements; for surgeons, it remains a troubling and often disheartening outcome; and for healthcare systems, it places added strain on resources by prolonging hospital stays and escalating overall treatment costs.[1-2] For surgeons, it is a critical concern due to the necessity for prompt re-intervention, the potential for serious complications such as evisceration, the likelihood of developing an incisional hernia, and the risk of recurrence, all of which can significantly impact patient outcomes.[3] Wound dehiscence most commonly occurs between the 7th and 10th postoperative days, although in some cases, it may present as late as 20 days after surgery.[4] Despite advancements in preoperative care—such as the use of broad-spectrum injectable antibiotics and a deeper understanding of how systemic illnesses impact wound healing—the overall incidence of wound dehiscence has not significantly declined and remains relatively unchanged.[5] Evisceration contributes to postoperative morbidity in approximately 20–45% of cases and is linked to an increased risk of mortality during the perioperative period.[6]

Numerous significant risk factors have been identified in relation to wound dehiscence. These include advanced age (over 65 years), low serum albumin levels, presence of wound infection, ascites, obesity, use of corticosteroids, chronic obstructive pulmonary disease (COPD), pneumonia, a history of stroke with lasting deficits, anemia (hematocrit below 30), extended postoperative ileus, persistent coughing after surgery, emergency surgical

procedures, operations lasting more than 2.5 hours, and surgeries performed by fourth-year postgraduate residents. [7-8] Chronic illnesses such as diabetes play a significant role in increasing the risk of wound infection and impairing the overall healing process. Diabetes disrupts multiple stages of wound healing and slows down tissue regeneration.[9-10] Wound healing can also be significantly delayed in individuals with dietary imbalances or conditions such as malabsorption, hypermetabolism, or catabolic states.[11] Inadequate intake or absorption of essential nutrients—including vitamins, minerals, proteins, carbohydrates, or fats—can impair the body's ability to synthesize the components necessary for effective tissue repair.[12-13]

A study found the prevalence and risk factors of wound dehiscence to be 5.9%, old age 20%, anemia 17%, smoking 7%, obesity 13%, wound infection 25% and paralytic ileus 14%.[14]

Wound dehiscence, a complication characterized by the partial or complete reopening of a surgical incision, presents a significant concern in patients undergoing emergency midline laparotomy. This complication can lead to severe morbidity, increased length of hospital stays, and higher healthcare costs. Understanding the frequency and identifying specific risk factors associated with wound dehiscence in this population is essential for improving patient outcomes. This study aims to fill existing knowledge gaps by analyzing the incidence and risk factors of wound dehiscence in patients undergoing emergency midline laparotomy, with the goal of developing preventative strategies and enhancing postoperative care.

MATERIAL AND METHODS

The study adopted a cross-sectional design and be conducted at the Department of Surgery, Jinnah Postgraduate Medical Centre (JPMC), Karachi, over a period of three months from 1st March 2025 to 31 May 2025, following approval of the research synopsis. A total of 175 patients were included in the study. This sample size has been calculated using WHO software, based on a previously reported wound dehiscence prevalence of 5.9%, with a 3.5% margin of error and a 95% confidence level.

Participants were selected through non-probability consecutive sampling. Eligible individuals included patients aged 30 to 80 years, of either gender, who were undergoing emergency midline laparotomy and classified as ASA ≤ 2. Patients were excluded if they had a history of malignancy, if the laparotomy was performed for intestinal obstruction, if wound dehiscence occurred following any gynecological procedures, or after a second surgery. Additionally, those with comorbidities such as congestive cardiac failure, chronic liver disease, chronic obstructive pulmonary disease, asthma, myocardial infarction, chronic kidney disease, or stroke were not included.

After receiving ethical clearance from institutional review board committee Jinnah Postgraduate Medical Centre, Reference no. (F.2-81/2025-GENL/213/JPMC) dated: 01-03-2025. The study began with patient enrollment in the emergency surgical unit. Informed written consent was obtained in the local language. Each participant underwent laparotomy through a midline incision under general anesthesia. As part of standard protocol, all patients received preoperative antibiotics upon admission for acute abdominal conditions; antibiotic therapy was adjusted postoperatively based on clinical need. Closure of the linea alba was done using non-absorbable monofilament synthetic suture (Prolene No. 1) in all cases.

Postoperative monitoring of the surgical wound commenced on the third day and continue thereafter. The wound was examined for signs such as redness, edema, and any discharge (purulent or serosanguinous). The diagnosis of wound dehiscence was made based on predefined clinical criteria. All relevant observations and patient characteristics were recorded in a structured data collection form prepared for the study.

Data analysis was conducted using SPSS version 22. Quantitative variables such as patient age and duration of surgery was analyzed for normality using the Kolmogorov–Smirnov test. Normally distributed variables will be reported as mean ± standard deviation, whereas non-normally distributed variables was expressed as median with interquartile ranges. Categorical data—including gender, residential status, ASA classification, occurrence of wound dehiscence, and associated risk factors (such as old age, anemia, smoking, obesity, wound infection, and postoperative ileus)—was summarized as frequencies and percentages. To account for potential confounding factors, stratification will be performed by age, gender, residential status, ASA grade, and surgical duration. Chi-square or Fisher's exact tests will be used post-stratification to assess the association between variables, with a p-value of ≤ 0.05 considered statistically significant.

RESULTS

The study included 175 patients who underwent emergency midline laparotomy. Most participants (73.7%) were between 30 and 50 years of age, while 26.3% were aged between 51 and 80 years. The gender distribution showed a slight predominance of female patients (52.6%) over males (47.4%). A larger proportion of patients came from rural areas (54.3%) compared to those from urban settings (45.7%). Regarding ASA classification, (53.7%) of patients were categorized as ASA II, whereas (46.3%) fell under ASA I.

Surgical duration was 1.5 hours or less in 68.6% of cases, while 31.4% of surgeries exceeded that timeframe. Anemia was present in 16% of the cohort. Only 42.6% of patients reported a history of smoking, and 14.9% met criteria for obesity. Postoperative wound infection occurred in 28% of patients, while 12% developed postoperative ileus. Overall, 10 patients (5.7%) experienced wound dehiscence, while 165 (94.3%) did not.

Table 1

Distribution of baseline characteristics among the study participants.

Variables	n (%)
Age	
30 to 50 years	129 (73.7)

51 to 80 years	46 (26.3)
Gender	
Male	83 (47.4)
Female	92 (52.6)
Residence status	
Urban	80 (45.7)
Rural	95 (54.3)
ASA status	
I	81 (46.3)
II	94 (53.7)
Duration of surgery	
≤ 1.5 hours	120 (68.6)
> 1.5 hours	55 (31.4)
Anemia status	
Yes	28 (16)
No	147 (84)
Smoking status	
Yes	07 (42.6)
No	85 (57.4)
Obesity status	
Yes	26 (14.9)
No	149 (85.1)
Wound infection	
Yes	49 (28)
No	126 (72)
Postoperative ileus	
Yes	21 (12)
No	154 (88)
Wound Dehiscence	
Yes	10 (5.7)
No	165 (94.3)
Total	**175 (100)**

A comparison of patient characteristics according to wound dehiscence status revealed no statistically significant associations. Among those who developed wound dehiscence, 70% were between 30 and 50 years of age, and 30% were aged 51 to 80 years (p = 0.78). The proportion of males and females with wound dehiscence was nearly identical (6% and 5.4%, respectively; p = 0.86). Rural residents had a slightly higher rate of dehiscence (6.3%) compared to their urban counterparts (5%; p = 0.70).

Wound dehiscence occurred in 7.4% of ASA I patients and 4.3% of those in ASA II (p = 0.37). Among patients who underwent shorter surgeries (≤2 hours), 6.7% developed wound dehiscence, while 3.6% of those with longer surgeries (>2 hours) experienced the complication (p = 0.42). Anemia did not appear to influence the outcome significantly, with 3.6% of anemic patients and 6.1% of non-anemic patients developing wound dehiscence (p = 0.59).

The rates of wound dehiscence among smokers (3.6%) and non-smokers (6.1%) also did not differ meaningfully (p = 0.59). A similar pattern was observed with obesity: 3.8% of obese and 6% of non-obese patients experienced dehiscence (p = 0.65). Wound infections were more common in patients with dehiscence (8.2%) than those without (4.8%), but this difference was not statistically significant (p = 0.38). Likewise, postoperative ileus occurred in 4.8% of patients with dehiscence, compared to 5.8% without (p = 0.84).

Table 2

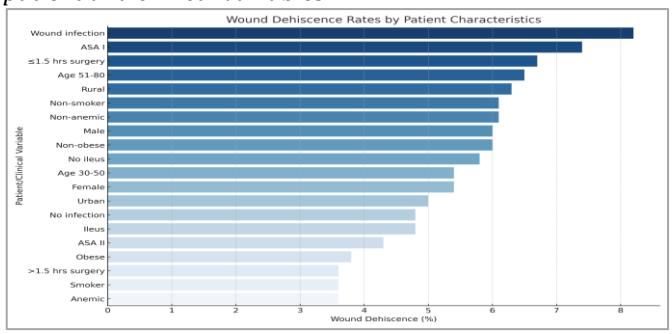
Distribution of patient characteristics according to the Wound Dehiscence.

Variables	Wound Dehiscence Yes n (%)	Wound Dehiscence No n (%)	P value
Age			0.78
30 to 50 years	07 (5.4)	122 (94.6)	
51 to 80 years	03 (6.5)	43 (93.5)	
Gender			0.86
Male	05 (6)	78 (94)	
Female	05 (5.4)	87 (94.6)	
Residence status			0.70
Urban	04 (5)	76 (95)	
Rural	06 (6.3)	89 (93.7)	
ASA status			0.37
I	06 (7.4)	75 (92.6)	
II	04 (4.3)	90 (95.7)	
Duration of surgery			0.42
≤ 2 hours	08 (6.7)	112 (93.3)	
> 2 hours	02 (3.6)	53 (96.4)	
Anemia status			0.59
Yes	01 (3.6)	27 (96.4)	
No	09 (6.1)	138 (93.9)	
Smoking status			
Yes	01 (3.6)	27 (96.4)	0.59
No	09 (6.1)	138 (93.9)	
Obesity status			
Yes	01 (3.8)	25 (96.2)	0.65
No	09 (6)	140 (94)	
Wound infection	04 (8.2)	45 (91.8)	0.38
Yes	06 (4.8)	120 (95.2)	
No			
Postoperative ileus	01 (4.8)	20 (95.2)	0.84
Yes	09 (5.8)	145 (94.2)	
No			

In summary, while wound dehiscence occurred in a small subset of patients, none of the assessed demographic, clinical, or operative variables demonstrated a statistically significant association with this complication.

Figure 1

Distribution of wound dehiscence rates across various patient and clinical variables.



DISCUSSION

We found a dehiscence rate of 5.7%. This falls within the range reported by earlier studies from similar low-resource surgical settings, where rates have ranged between 5.9% and 17%.[15-19] These variations likely reflect differences in how perioperative care is delivered, how well patients are optimized preoperatively, and the experience of the surgical teams.

Our data did not show any statistically significant relationship between wound dehiscence and the demographic or clinical factors we analyzed. Variables such as age, sex, area of residence, ASA class, surgery duration, anemia, obesity, smoking status, and postoperative complications like wound infection and ileus did not predict dehiscence risk in this population. This finding is consistent with Hegazy and Soliman's work,

which also reported that these individual characteristics were not reliable predictors in emergency laparotomy cases. [17]

One possible explanation for these null findings lies in confounding factors that we did not measure. Variables such as the patient's nutritional status, glucose control, or the technical performance of the surgery could have influenced outcomes but remained unaccounted for. Since we used a cross-sectional design, we also could not establish whether exposures preceded outcomes, which limits our ability to infer causality.

Studies have suggested that older age increases the risk of fascial breakdown due to delayed collagen synthesis and impaired tissue repair. [20-21] Our results support previous findings that age may not independently predict dehiscence. [17,22] Sex did not influence outcomes in our study. Comparable research by Waqar et al. and Kenig et al., also found no significant differences between male and female patients. [15,20]

We did note that wound infections occurred more frequently among patients who developed dehiscence (8.2%) compared to those who did not (4.8%), but the difference was not statistically significant. Previous studies have highlighted surgical site infection as a key contributor to fascial disruption. [16,21-22] However, our findings may reflect effective postoperative infection control measures that mitigated this risk.

Surprisingly, patients without anemia or obesity experienced slightly higher rates of wound dehiscence than those with these conditions. This unexpected trend may reflect Simpson's paradox. [23] Where associations at the subgroup level can reverse or disappear when data are aggregated. This often happens due to imbalances in confounding variables. [23] These patterns underscore the complexity of interpreting observational data without stratification or multivariable analysis. [23]

Our study design may have introduced selection bias, [23] as we excluded patients with major comorbidities, malignancies, or reoperations. This approach, although intended to reduce heterogeneity, may have limited our ability to capture the full spectrum of risk. Additionally, relying on non-probability sampling could have skewed the sample toward particular types of cases. Information bias might also have affected our findings, especially if variables like smoking or comorbid conditions were underreported or misclassified. [23]

Surgery duration also failed to emerge as a meaningful predictor, even though prior studies have associated longer operative times with greater tissue handling and contamination risk. [15,23] Interestingly, in our data some of the dehiscence cases occurred among those patients who underwent shorter procedures. This suggests that operative time alone may not accurately reflect surgical complexity.[24-25]

ASA classification similarly showed no association with dehiscence. Although this could be due to the narrow range in our sample: as only ASA I and II patients were included. In another research, higher ASA grades have been linked with worse surgical outcomes.[26-27]

Our findings reinforce the view that wound dehiscence arises from a convergence of factors, [23] rather than any single dominant cause. The interaction between surgical technique, baseline health status, perioperative care, and perhaps unmeasured systemic stress likely determines outcomes, a conclusion supported previous local and international studies. [15,17,18, 28, 29]

To reduce the incidence of wound dehiscence, clinicians must adopt a holistic approach. Rather than relying on isolated risk markers, teams should prioritize meticulous closure techniques, proactive infection control, and vigilant postoperative care. Especially in vulnerable patients with poor nutritional reserves. Beyond individual-level risk, structural and systemic factors, such as delayed referrals, limited access to surgical services, or staff shortages, may also shape outcomes in emergency settings and deserve further attention. [30-31]

Future research should focus on prospective, multicenter designs that incorporate objective clinical and biochemical indicators. For instance, serum albumin, inflammatory markers, or glycemic control. These data could strengthen existing risk models and guide more tailored, preventive strategies for high-risk surgical patients. [32]

LIMITATIONS

This study has a few important limitations. We used a cross-sectional design. We were unable to establish causal relationships between specific risk factors and the development of wound dehiscence. Our use of non-probability consecutive sampling, may have introduced selection bias and limited the broader applicability of our findings. We also excluded patients with multiple chronic comorbidities (including malignancy, cardiac and respiratory diseases) which may have led us to underestimate the true incidence of wound dehiscence in more complex surgical populations. In addition, we did not collect nutritional or biochemical markers such as serum albumin or glycemic indices. This could have provided a more detailed assessment of wound healing risk. As a single-center study. Our findings may also reflect specific institutional practices or surgical techniques that may not be generalizable to other settings.

CONCLUSION

We found that 5.7% of patients who underwent emergency midline laparotomy developed wound dehiscence. None of the demographic, clinical, or intraoperative factors we analyzed showed a significant association with this complication. These results suggest that wound dehiscence likely results from a combination of influences rather than any single identifiable risk factor.

REFERENCES

1. Crum, N. F. (2003). Current trends in typhoid fever. *Current Gastroenterology Reports*, *5*(4), 279-286. https://doi.org/10.1007/s11894-003-0064-0
2. Afzal, S., & Bashir, M. M. (2008). Determinants of wound dehiscence in abdominal surgery in public sector hospital. *Annals of King Edward Medical University*, *14*(3), 119-119. https://doi.org/10.21649/akemu.v14i3.46
3. Talukdar, M., Gopalarathnam, S., Paul, R., & Rahim Shaan, A. (2016). Clinical study on factors influencing wound dehiscence in emergency exploratory laparotomy. *Journal of Evolution of Medical and Dental Sciences*, *5*(34), 1934-1938. https://doi.org/10.14260/jemds/2016/457
4. Hegazy, T., & Soliman, S. (2020). Abdominal wall dehiscence in emergency midline laparotomy: Incidence and risk factors. *The Egyptian Journal of Surgery*, *39*(2), 489. https://doi.org/10.4103/ejs.ejs_7_20
5. Hanif, M., Ijaz, A., Niazi, U. F., Akhtar, I., Zaidi, A. A., & Mussadiq, M. (2001). Acute wound failure in emergency and elective laparotomies. *JOURNAL-COLLEGE OF PHYSICIANS AND SURGEONS OF PAKISTAN*, *11*, 23-26.
6. Jones, V., Bale, S., & Harding, K. (2003). Acute and chronic wound healing. *Baranoski, S. & Ayello, EA (Eds.), Wound Care Essentials: Practice Principles*, 72-73.
7. Mäkelä, J. T., Kiviniemi, H., Juvonen, T., & Laitinen, S. (1995). Factors influencing wound dehiscence after midline laparotomy. *The American Journal of Surgery*, *170*(4), 387-390. https://doi.org/10.1016/s0002-9610(99)80309-2
8. Webster, C., Neumayer, L., Smout, R., Horn, S., Daley, J., Henderson, W., & Khuri, S. (2003). Prognostic models of abdominal wound dehiscence after laparotomy. *Journal of Surgical Research*, *109*(2), 130-137. https://doi.org/10.1016/s0022-4804(02)00097-5
9. Muneiah, N. S., Kumar, N. M., Sabitha, P., & Prakash, D. G. (2015). Abdominal wound dehiscence-a look into the risk factors. *IOSR J Dent Med Sci*, *14*(1), 47-54.
10. Hurd, W. W., Bude, R. O., DeLancey, J. O., & Newman, J. S. (1994). The location of abdominal wall blood vessels in relationship to abdominal landmarks apparent at laparoscopy. *American Journal of Obstetrics and Gynecology*, *171*(3), 642-646. https://doi.org/10.1016/0002-9378(94)90076-0
11. Sibbald, R. G., Ostrow, B., Lowe, J., Ayello, E. A., Alavi, A., Botros, M., ... & Smart, H. (2012). Screening for the high-risk diabetic foot: a 60-second tool (2012)©: diabetes. *Wound Healing Southern Africa*, *5*(2), 72-82. https://hdl.handle.net/10520/EJC129079
12. Wagner, A., Huck, G., Stiehl, D., Jelkmann, W., & Hellwig-Bürgel, T. (2008). Dexamethasone impairs hypoxia-inducible factor-1 function. *Biochemical and Biophysical Research Communications*, *372*(2), 336-340. https://doi.org/10.1016/j.bbrc.2008.05.061
13. Hong, W. X., Hu, M. S., Esquivel, M., Liang, G. Y., Rennert, R. C., McArdle, A., Paik, K. J., Duscher, D., Gurtner, G. C., Lorenz, H. P., & Longaker, M. T. (2014). The role of hypoxia-inducible factor in wound healing. *Advances in Wound Care*, *3*(5), 390-399. https://doi.org/10.1089/wound.2013.0520
14. Waqar, S. H., Malik, Z. I., Razzaq, A., Abdullah, M. T., Shaima, A., & Zahid, M. A. (2005). Frequency and risk factors for wound dehiscence/burst abdomen in midline laparotomies. *Journal of Ayub Medical College Abbottabad*, *17*(4). https://jamc.ayubmed.edu.pk/index.php/jamc/article/view/4203
15. Waqar, S. H., Malik, Z. I., Razzaq, A., Abdullah, M. T., Shaima, A., & Zahid, M. A. (2005). Frequency and risk factors for wound dehiscence/burst abdomen in midline laparotomies. *Journal of Ayub Medical College Abbottabad*, *17*(4). https://jamc.ayubmed.edu.pk/index.php/jamc/article/view/4203
16. Naeem, M., Khattak, I. A., Samad, A., & Waheed, R. (2017). Burst abdomen: A common surgical problem. *Journal of Medical Sciences*, *25*(2), 213-217. https://jmedsci.com/index.php/Jmedsci/article/view/53
17. Hegazy, T. O., & Soliman, S. S. (2020). Abdominal wall dehiscence in emergency midline laparotomy: incidence and risk factors. *The Egyptian Journal of Surgery*, *39*(2). https://ejsur.journals.ekb.eg/article_364594.html
18. Junaid, F., Usama, M., Anwar, F., Khan, S., ur Rahman, F., & Asad, S. (2022). Sociodemographic and operative factors associated with abdominal wound dehiscence in midline laparotomies. *The Professional Medical Journal*, *29*(10), 1448-1453. https://www.theprofesional.com/index.php/tpmj/article/view/6710
19. SHABBIR, G., AMER, M. S., & RASHID, M. U. (2011). Skin closure in laparotomy. *The Professional Medical Journal*, *18*(04), 552-556. https://doi.org/10.29309/tpmj/2011.18.04.2574
20. SIRAJ, A., GILANI, A. A., DAR, M. F., & Raziq, S. (2011). Elective midline laparotomy. *The Professional Medical Journal*, *18*(01), 106-111. https://doi.org/10.29309/tpmj/2011.18.01.1869
21. Soomro AG, Siddiqui FG, Agha AH, et al. Selective nasogastric decompression after elective laparotomy. J Liaquat Univ Med Health Sci. 2008;7(3):177–179. https://doi.org/10.22442/jlumhs.08720171
22. KHAN, T. A., AWAN, S. H., KHAN, S. A., & Amin, S. (2013). An audit of laparotomies;. *The Professional Medical Journal*, *20*(02), 279-283. https://doi.org/10.29309/tpmj/2013.20.02.686
23. Kenig, J., Richter, P., Lasek, A., Zbierska, K., & Zurawska, S. (2014). The efficacy of risk scores for predicting abdominal wound dehiscence: A case-controlled validation study. *BMC Surgery*, *14*(1). https://doi.org/10.1186/1471-2482-14-65
24. Col C, Soran A, Col M. Can post-abdominal wound dehiscence be predicted? Tokai J Exp Clin Med. 1998;23(3):123–127.
25. Riou, J. A., Cohen, J. R., & Johnson, H. (1992). Factors influencing wound dehiscence. *The American Journal of Surgery*, *163*(3), 324-330. https://doi.org/10.1016/0002-9610(92)90014-i
26. Rothman, K. J., Greenland, S., & Lash, T. L. (2008). *Modern epidemiology* (Vol. 3). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.
27. Muneiah, N. S., Kumar, N. M., Sabitha, P., & Prakash, D. G. (2015). Abdominal wound dehiscence-a look into the risk factors. *IOSR J Dent Med Sci*, *14*(1), 47-54.
28. Windsor, J. A., Knight, G. S., & Hill, G. L. (1988). Wound healing response in surgical patients: Recent food intake is more important than nutritional status. *Journal of British Surgery*, *75*(2), 135-137. https://doi.org/10.1002/bjs.1800750215
29. Kapoor, K. K. (2017). *A Clinical Study of Abdominal Wound Dehiscence with Emphasis on Surgical Management at a Tertiary Care Hospital* (Master's thesis, Rajiv Gandhi University of Health Sciences (India)).
30. Van Ramshorst, G. H., Nieuwenhuizen, J., Hop, W. C., Arends, P., Boom, J., Jeekel, J., & Lange, J. F. (2009). Abdominal wound dehiscence in adults: Development and validation of a risk model. *World Journal of Surgery*, *34*(1), 20-27. https://doi.org/10.1007/s00268-009-0277-y

31. Talati, J., Drago, P., Ali, Z., & Hasan, N. (1987). Low cost nutritional assessment of surgical patients in Third World countries. *Journal of the Pakistan Medical Association*, *37*(4), 86-89. https://scholars.aku.edu/en/publications/low-cost-nutritional-assessment-of-surgical-patients-in-third-wor/

32. Henriksen, N. A., Deerenberg, E. B., Venclauskas, L., Fortelny, R. H., Miserez, M., & Muysoms, F. E. (2018). Meta-analysis on materials and techniques for laparotomy closure: The MATCH review. *World Journal of Surgery*, *42*(6), 1666-1678. https://doi.org/10.1007/s00268-017-4393-9