Original Article

Access this article online

Quick Response Code:

Website: www.herniasurgeryjournal.org

DOI: 10.4103/ijawhs.ijawhs_94_24

Evaluation of mortality risk and surgical outcomes based on Charlson comorbidity index in emergency hernia repair patients

Mustafa Karaagac, Sedat Carkit

Abstract

CONTEXT: Hernias are common surgical conditions that may require emergency interventions due to complications such as strangulation, bowel obstruction, or ischemia. These situations significantly impact clinical outcomes and necessitate robust risk assessment tools.

AIMS: To evaluate mortality risk and surgical outcomes in emergency hernia repair patients using the Charlson comorbidity index (CCI) and to optimize clinical decision-making processes.

SETTINGS AND DESIGN: A retrospective study conducted at our General Surgery Clinic from 2021 to 2023.

MATERIALS AND METHODS: Data from 159 patients undergoing emergency hernia surgery were retrospectively analyzed. Variables included demographic data, hernia types, surgical interventions, and clinical outcomes. CCI and American Society of Anesthesiologists scores were calculated, and their impacts on mortality were assessed using logistic regression and chi-square tests.

STATISTICAL ANALYSIS USED: Logistic regression, chi-square tests, and cross-tabulation analyses.

RESULTS: Patients with a CCI score of 3–4 showed a significantly higher mortality risk ($P = 0.000$), while those with scores ≥5 exhibited elevated but statistically insignificant mortality risks ($P = 0.141$). Mortality was significantly associated with intestinal resection ($P = 0.001$). The time of presentation correlated with the likelihood of requiring resection ($P = 0.000$).

CONCLUSION: CCI is a reliable predictor of mortality risk in emergency hernia repair patients. Early risk assessment and timely intervention are crucial for improving outcomes.

Keywords:

ASA score, Charlson comorbidity index, emergency hernia repair, mortality risk, surgical outcomes

Introduction

Hernias are common surgical conditions characterized by the protrusion of intra-abdominal structures through weak points in the abdominal wall.[1] These pathologies often necessitate both elective and emergency surgical interventions worldwide.[1] Although most hernias are managed under elective conditions, complications such as strangulation, bowel obstruction, or ischemia can lead to emergencies requiring prompt surgical intervention.[2] These acute scenarios not only significantly impact the clinical course of patients but also contribute to increased mortality rates.[3] Therefore, the evaluation and management of emergency hernia cases, particularly in high-risk patient groups, are of paramount importance.

The Charlson comorbidity index (CCI) is a widely used scoring system for assessing preexisting comorbid conditions and predicting patient prognosis.[4] Based on

Department of General Surgery, Erciyes University Faculty of Medicine, Kayseri, Turkey

Address for correspondence:
Dr. Sedat Carkit, Department of General Surgery, Erciyes University Faculty of Medicine, Kayseri 38030, Turkey.
E-mail: opdrsedatcarkit@gmail.com

Submitted: 27-Nov-2024
Revised: 13-Feb-2025
Accepted: 19-Feb-2025
Published: 23-Jun-2025

How to cite this article: Karaagac M, Carkit S. Evaluation of mortality risk and surgical outcomes based on Charlson comorbidity index in emergency hernia repair patients. Int J Abdom Wall Hernia Surg 2025;8:76-81.

age and associated comorbidities, CCI serves as a clinical guide for estimating long-term mortality risk.[5] In cases requiring surgical intervention, a high CCI score is recognized as a significant factor contributing to increased postoperative complications and mortality risk.[4] Within this context, the use of CCI to predict the prognosis of patients undergoing emergency hernia surgery can play a pivotal role in defining surgical management strategies.

Several factors influence mortality and morbidity in emergency hernia cases, including the timing of presentation, the nature of the surgical procedure, the type of hernia, and the patient's overall health status.[6] Early evaluation of patients requiring emergency surgery and accurate identification of comorbidities are critical for determining appropriate treatment strategies. However, the impact of CCI and other clinical parameters on mortality in hernia cases requiring emergency surgical intervention remains incompletely understood.

This study aims to evaluate the prognostic value of CCI in emergency hernia cases, predict mortality risk in this patient group, and optimize surgical decision-making processes accordingly. The findings of this study are expected to underscore the clinical relevance of CCI in emergency hernia repair and provide a framework for guiding surgical management strategies in such cases. Additionally, the study seeks to contribute to the development of preventive strategies aimed at reducing mortality rates in high-risk patient groups.

Materials and Methods

This retrospective study was conducted to evaluate patients who underwent emergency surgical intervention for hernia at the General Surgery Clinic of Erciyes University Faculty of Medicine between 2021 and 2023. Data for the study were collected using the electronic medical records system, operative reports, and outpatient follow-up notes. Patients who underwent emergency hernia surgery and were followed postoperatively in our clinic were included in the study. Inclusion criteria required patients to be aged 18 years or older and to have undergone surgery at our General Surgery Clinic. Patients who underwent surgery or postoperative follow-up at other centers were excluded from the study.

At the beginning of the study, detailed records of the patients' demographic characteristics (age and gender), hernia types (incisional, umbilical, inguinal, and femoral), time of presentation, and preoperative and postoperative clinical findings were collected. Hernia types were categorized individually, and the clinical course of each patient, surgical procedures performed, complications, and mortality outcomes were analyzed. Patients who underwent intestinal resection during surgery were grouped separately from those who did not, and the clinical and demographic differences between these groups were evaluated. The decision for resection was based on intraoperative findings such as bowel necrosis, strangulation, or perforation.

CCI was used to evaluate the comorbidity status of patients, and the CCI score for each patient was calculated using data obtained from electronic medical records. The impact of different CCI categories (0, 1–2, 3–4, and ≥5) on mortality was examined through logistic regression analysis. Additionally, the relationship between the time of presentation (24, 48, 72, 96, and 120 h) and resection rates was analyzed using the chi-square test. Pearson's chi-square test and the linear-by-linear association test were utilized to assess the relationship between the time of presentation and resection.

In the postoperative period, mortality rates and their associations with CCI, "American Society of Anesthesiologists" (ASA) scores, and other clinical variables were analyzed. Patients were grouped based on their ASA scores (ASA 1, ASA 2, and ASA 3), and the effect of each group on mortality was evaluated. Statistical analyses were performed using SPSS version 22.0 (IBM Corp., Armonk, NY, USA), and results with a P value of <0.05 were considered statistically significant. To evaluate the explanatory power of the logistic regression model, Cox & Snell R square and Nagelkerke R square values were calculated.

Additionally, the effects of various clinical parameters, including bowel obstruction, a history of malignancy, abdominal tenderness, distension, peritonitis, skin findings, and other clinical variables, on mortality were analyzed in detail. Mortality rates in patients who underwent intestinal resection were compared with those who did not, and the statistical significance of this relationship was tested using cross-tabulation analysis. Fisher's exact test was used to confirm the significance of the association between resection and mortality.

CCI is a validated scoring system designed to quantify comorbid conditions and predict long-term mortality risk.[7] The index incorporates 19 predefined comorbidities; each assigned a weighted score based on its impact on survival. For instance, conditions such as myocardial infarction, diabetes, and chronic pulmonary disease contribute one point, while metastatic solid tumors and severe liver disease contribute higher scores (up to six points). Additionally, age is factored into the scoring, with each decade beyond 40 years adding an extra point to the total score. The cumulative CCI score provides a structured framework for assessing baseline patient risk, particularly in surgical settings. Higher

CCI scores (≥3) have been associated with increased postoperative complications and mortality, making CCI a valuable tool for preoperative risk stratification. In our study, CCI scores were calculated using electronic medical records, and patients were categorized into four groups based on their scores (0, 1–2, 3–4, and ≥5) to assess the relationship between comorbidity burden and surgical outcomes.

The study was conducted with the approval of the local Ethic Committee (Ethics Approval Number: 231/2024) and in accordance with the ethical principles of the Declaration of Helsinki. The identities of all patients were kept confidential, and personal information was protected. Data security was ensured through electronic record systems and encryption methods, with access limited to the research team. Compliance with ethical requirements was regularly reviewed throughout the study.

Results

A total of 159 patients were evaluated in the study. Of these, 49.1% were male (78 patients) and 50.9% were female (81 patients). The mean age was calculated as 61.18 years (minimum: 21 and maximum: 83). The average age was 60.96 years for male patients and 61.38 years for female patients. The distribution of age and gender is detailed in Table 1.

Table 1: Patient demographics and distribution of hernia types

Characteristic	Value	Percentage (%)	*n* (patient count)
Total number of patients	159	–	159
Gender	–	–	–
Male	–	49.1	78
Female	–	50.9	81
Average age	61.18 ± 12.232 years	–	–
Male	60.96 ± 12.729 years	–	–
Female	61.38 ± 11.808 years	–	–
Hernia types	–	–	–
Incisional hernia	–	23.3	37
Umbilical hernia	–	25.2	40
Inguinal hernia	–	35.2	56
Femoral hernia	–	16.4	26

When the distribution of hernia types was examined, 23.3% of the patients had incisional hernias (37 patients), 25.2% had umbilical hernias (40 patients), 35.2% had inguinal hernias (56 patients), and 16.4% had femoral hernias (26 patients). The distribution of hernia types is also presented in Table 1.

Regarding the relationship between CCI and mortality, it was found that patients with a CCI score of 5 or higher had a 3.429 times higher risk of mortality compared to those with a CCI score of 0. However, this increase was not statistically significant ($P = 0.141$). In contrast, a significant increase was observed in the CCI category of 3–4 ($P = 0.000$), indicating a statistically meaningful elevation in mortality risk in this group. The effects of CCI categories on mortality and their comparisons are provided in Table 2. A visual comparison of these categories, along with the changes in mortality risk with increasing CCI, is illustrated in Figure 1. This figure highlights the differences between groups with lower and higher CCI scores, clearly demonstrating the increase in mortality rates.

Evaluation based on ASA scores revealed that the ASA 3 group demonstrated borderline statistical significance for mortality ($P = 0.062$), with an Exp(B) value of 3.893. No significant effect was observed in the ASA 1 and ASA 2 groups. The impact of ASA scores on mortality is also included in Table 2. Analysis of the age variable showed a P value of 0.999, indicating that age did not have a statistically significant effect on mortality (as shown in Table 2).

According to the logistic regression analysis, small bowel obstruction was identified as the only variable demonstrating borderline significance for mortality ($P = 0.079$), with an Exp(B) value of 6.501. Other clinical

Table 2: Results of logistic regression analysis for the impact of Charlson comorbidity index, American Society of Anesthesiologists (ASA) score, and age on mortality

Variable	Exp(B)	Wald test	*P* value	Confidence interval (lower–upper)
Charlson comorbidity index 0	1.000	2.165	0.539	–
Charlson comorbidity index 1–2	1.000	0.000	0.999	969,284,918.5–>10^9
Charlson comorbidity index 3–4	1.000	0.000	0.000	969,284,919.0–>10^9
Charlson comorbidity index 5 and above	3.429	2.165	0.141	0.664–17.696
ASA score 1	2.667	0.679	0.410	0.259–27.485
ASA score 2	430,732,997.2	0.000	0.997	0.000
ASA score 3	3.893	3.484	0.062	0.934–16.226
Constant	3.750	5.517	0.019	–
Age	0.244	0.0	0.999	–

variables, such as a history of malignancy, skin findings, abdominal tenderness, distension, and others, did not show a statistically significant effect on mortality. The effects of these variables on mortality are summarized in Table 3.

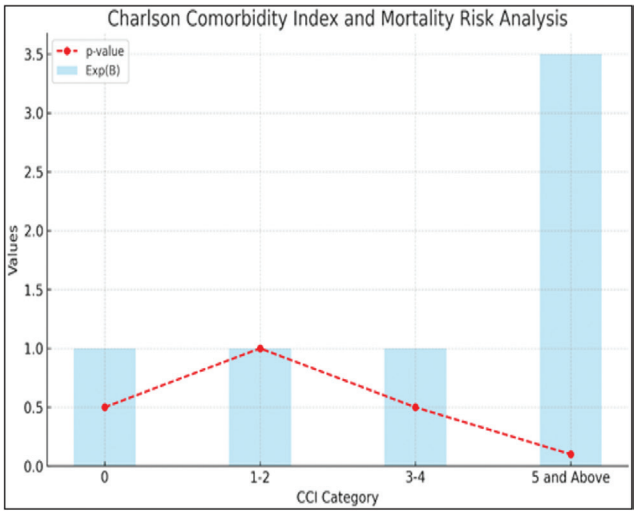

Figure 1: Mortality risk analysis based on "Charlson comorbidity index" categories in patients undergoing emergency surgery for hernia

Regarding the impact of the resection variable on mortality, it was found that patients who underwent resection had a significantly increased risk of mortality ($P = 0.001$), with an Exp(B) value of 31.636. The Cox & Snell R square value of the model was calculated as 0.116, and the Nagelkerke R square value as 0.308, indicating that the model explains 30.8% of the variability in mortality. The impact of resection on mortality and the details of this relationship are presented in Table 4.

In the cross-tabulation analysis examining the relationship between mortality and resection, it was observed that 10 out of 159 patients experienced mortality. Of these, nine deaths occurred in patients who underwent resection, while only one death was noted in the group without resection. These findings establish a statistically significant relationship between resection and mortality (Pearson's chi-square test: $P = 0.000$; Fisher's exact test: $P = 0.000$). The results of the cross-tabulation and related findings are detailed in Table 4.

The relationship between the time of presentation and resection was also analyzed. Of the 159 patients, 42 underwent resection, the majority of whom presented within 24–72 h. The highest resection rate

Table 3: Results of logistic regression analysis for the effects of independent variables on mortality

Independent variable	*B* (coefficient)	S.E. (standard error)	Wald	*df*	*P* value	Exp(*B*) (odds ratio)
Small bowel obstruction	1.872	1.067	3.08	1	0.079	6.501
History of malignancy	1.166	1.235	0.891	1	0.345	3.209
Skin findings	0.734	0.747	0.965	1	0.326	2.084
Abdominal tenderness	0.841	0.887	0.899	1	0.343	2.319
Distension	0.877	0.755	1.348	1	0.246	2.403
Peritonitis	−17.979	16,506.544	0.0	1	0.999	0.0
Bowel wall thickening	−18.931	14,325.262	0.0	1	0.999	0.0
Free air	−19.671	19,817.315	0.0	1	0.999	0.0
Free fluid	−0.284	0.734	0.150	1	0.699	0.753
Pneumonitis intestinalis	22.042	14,298.106	0.0	1	0.999	3,738,842,042.951

Table 4: Consolidated results of resection and presentation time (headings included as rows)

Independent variable/mortality/ time of presentation (h)	B (coefficient)/ resection performed	S.E. (standard error)/no resection	Wald/ total	*df*/ notes	*P* value/Exp(B) (odds ratio)	Exp(B)/ results
Results of logistic regression analysis: Independent variable						
Resection	3.454	1.072	10.376	1	0.001	31.636
Cross-tabulation results – mortality and resection: mortality						
Present	9	1	10	–	–	–
Absent	33	116	149	–	–	–
Total	42	117	159	–	–	–
Cross-tabulation results – time of presentation and resection: Time of presentation (h)						
24	2	63	65	–	–	–
48	17	45	62	–	–	–
72	14	7	21	–	–	–
96	8	2	10	–	–	–
120	1	0	1	–	–	–
Total	42	117	159	–	–	–

was observed in the group with a presentation time of 48 h. Most of the patients who did not undergo resection were concentrated in the group presenting within 24 h. Pearson chi-square test results ($P = 0.000$) and the linear-by-linear association test (51.643) demonstrated a significant relationship between the time of presentation and resection. These results are detailed in Table 4.

The effects of CCI groups on mortality risk are graphically illustrated in the figure. This figure highlights the differences in mortality rates between groups with a CCI of 0 and those with a CCI of 5 or higher, clearly showing the rise in mortality risk as CCI increases.

Discussion

This study examined how mortality risks varied among patients undergoing emergency surgical intervention for hernia when evaluated using the CCI. In our findings, patients with a CCI score of 3–4 exhibited a significantly increased mortality risk. This observation underscores the higher surgical risk associated with this patient group due to their level of comorbidity and highlights the need for careful assessment of outcomes in such cases.[8] Although patients with a CCI score of 5 or higher also demonstrated an elevated mortality risk, this increase did not reach statistical significance. This may suggest that patients in this category are more heterogeneous, and the sample size for this group might have been insufficient.

Evaluation based on ASA scores indicated a trend toward increased mortality risk, particularly in the ASA 3 group.[9] This finding suggests that patients in this group require closer monitoring and a more thorough assessment of preoperative risk factors. Conversely, no significant increase in mortality risk was observed in patients within the ASA 1 and ASA 2 groups, reflecting their generally stable clinical course and lower risk of complications. However, when considered alongside CCI, ASA scores may provide more meaningful insights into predicting surgical outcomes. While CCI provides a detailed evaluation of comorbidity levels, ASA measures the overall risk associated with anesthesia.[10] The combined use of these two scoring systems may offer a more robust prognostic tool.[11]

Consequently, integrating these scoring systems could enhance surgical planning and decision-making, particularly for high-risk patient groups. This approach may lead to better identification of risk factors and improved outcomes in emergency hernia surgeries.

The differences between patients who underwent resection and those who did not were also highlighted in this study. It was found that the risk of mortality was significantly higher in patients requiring resection. This finding underscores the substantial impact of complications such as bowel necrosis, strangulation, or perforation on surgical outcomes during emergency surgery.[12] Patients who underwent resection represented a high-risk group requiring more intensive postoperative care. Therefore, these patients should be subjected to more comprehensive and meticulous monitoring during both the preoperative and postoperative periods.

The significant relationship observed between the time of presentation and the need for resection highlights the critical importance of early presentation in emergency hernia cases.[13] In our study, the group presenting at 48 h showed the highest rates of resection. This finding suggests that patients presenting late with hernia are more likely to experience severe complications, leading to more complex and risky surgical interventions.[6] Early presentation can reduce the likelihood of complications, thereby enhancing the success of surgical procedures and improving the overall management of patients' health.

Our study also identified CCI as a strong predictor of mortality when evaluated alongside independent variables such as the time of presentation. Cross-tabulation analyses further demonstrated the impact of CCI categories and resection status on mortality. These analyses support the notion that mortality varies depending on the time of presentation and the pathological findings encountered during surgery.[14] When other clinical parameters (e.g., bowel obstruction, skin findings, and peritonitis) were analyzed, their effects on mortality were found to be statistically insignificant.

The evaluation of patients undergoing emergency surgery for hernia using the CCI, ASA provides a valuable guide for predicting patient prognosis and determining surgical management strategies. This study identified that patients with a CCI score of 3–4 face a significantly higher risk of mortality, with this risk further increasing markedly in cases requiring resection. Additionally, the timing of presentation was observed to have a direct correlation with the complexity and outcomes of surgical intervention. These findings emphasize the importance of considering CCI and presentation time in the clinical decision-making process for patients requiring emergency hernia surgery and highlight their critical role in improving outcomes.

In light of these findings, although CCI score and time to presentation are non-modifiable factors, they play a decisive role in determining prognosis. Early identification of patients with a high CCI score, particularly those within the 3–4 range, may facilitate targeted preoperative optimization and allow for the anticipation of intensive

care needs.[7] Similarly, the increased mortality risk associated with delayed presentation underscores the necessity of developing emergency triage protocols and prioritizing early surgical assessment.[6] Integrating these strategies may enhance resource utilization, personalize perioperative care, and ultimately contribute to reducing mortality rates. In patients with a high CCI score or delayed presentation, intraoperative and postoperative management can be more effectively structured through approaches such as damage-control surgery or staged procedures.[7,12,14] Thus, despite the presence of non-modifiable risk factors, appropriate clinical planning and intensive care arrangements may improve patient outcomes. In conclusion, considering prognostically critical factors such as CCI and time to presentation in emergency hernia surgery plays a significant role in optimizing surgical planning and management through a multidisciplinary approach, thereby contributing to reduced mortality rates.

Author contributions

We certify that we have participated sufficiently in the intellectual content, conception and design of this work or the analysis and interpretation of the data (when applicable), as well as the writing of the manuscript, to take public responsibility for it and have agreed to have our name listed as a contributor.

Ethical policy and institutional review board statement

This study was conducted with the approval of the Clinical Research Ethics Committee of Erciyes University (Ethics Approval Number: 231/2024). The study adhered to the ethical principles outlined in the Declaration of Helsinki. All patient identities were kept confidential, and personal information was protected. Data security was ensured through electronic record systems and encryption methods, with access restricted to the research team. Compliance with ethical requirements was regularly reviewed throughout the study.

Declaration of patient consent

In this study, informed consent was obtained from the patients, and their agreement to participate in the study was documented.

Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Abbreviations

ASA American Society of Anesthesiologists
CCI Charlson comorbidity index

References

1. Ali IM, Shetty K S, Shetty V. A clinical study of anterior abdominal wall hernias and its management: A medical college experience. Cureus 2024;16:e67209.
2. Lindmark M, Strigård K, Löwenmark T, Dahlstrand U, Gunnarsson U. Risk factors for surgical complications in ventral hernia repair. World J Surg 2018;42:3528-36.
3. Pandya B, Huda T, Gupta D, Mehra B, Narang R. Abdominal wall hernias: An epidemiological profile and surgical experience from a rural medical college in central India. Surg J (N Y) 2021;7:e41-6.
4. Qu WF, Zhou PY, Liu WR, Tian MX, Jin L, Jiang XF, *et al*. Age-adjusted Charlson Comorbidity Index predicts survival in intrahepatic cholangiocarcinoma patients after curative resection. Ann Transl Med 2020;8:487.
5. Dhakal P, Shostrom V, Al-Kadhimi ZS, Maness LJ, Gundabolu K, Bhatt VR. Usefulness of Charlson comorbidity index to predict early mortality and overall survival in older patients with acute myeloid leukemia. Clin Lymphoma Myeloma Leuk 2020;20:804-12.e8.
6. Leeds IL, Jones C, DiBrito SR, Sakran JV, Haut ER, Kent AJ. Delay in emergency hernia surgery is associated with worse outcomes. Surg Endosc 2020;34:4562-73.
7. Charlson ME, Carrozzino D, Guidi J, Patierno C. Charlson comorbidity index: A critical review of clinimetric properties. Psychother Psychosom 2022;91:8-35.
8. Comoglu S, Kant A. Does the Charlson comorbidity index help predict the risk of death in COVID-19 patients? North Clin Istanb 2022;9:117-21.
9. Yurtlu DA, Aksun M, Ayvat P, Karahan N, Koroglu L, Aran G. Comparison of risk scoring systems to predict the outcome in ASA-PS V patients undergoing surgery: A retrospective cohort study. Medicine (Baltimore) 2016;95:e3238.
10. Hackett NJ, De Oliveira GS, Jain UK, Kim JY. ASA class is a reliable independent predictor of medical complications and mortality following surgery. Int J Surg 2015;18:184-90.
11. Cher EWL, Carson JA, Sim EY, Abdullah HR, Howe TS, Bee JKS. Developing a simpler prognosticating tool: Comparing the combined assessment of risk encountered in surgery score with Deyo-Charlson comorbidity index and the American society of anesthesiologists physical status score in predicting 2 years mortality after hip fracture surgery. Geriatr Orthop Surg Rehabil 2021;12:21514593211036235.
12. McCoy CC, Englum BR, Keenan JE, Vaslef SN, Shapiro ML, Scarborough JE. Impact of specific postoperative complications on the outcomes of emergency general surgery patients. J Trauma Acute Care Surg 2015;78:912-8; discussion 918.
13. Singh A, Paruthy SB, Aradhya PS, Chavda J, Pal S. Rare hernias as surgical emergencies: A case series of five cases. Cureus 2023;15:e41064.
14. Sartelli M, Coccolini F, Van Ramshorst GH, Campanelli G, Mandalà V, Ansaloni L, *et al*. WSES guidelines for emergency repair of complicated abdominal wall hernias. World J Emerg Surg 2013;8:1-11.