Therapeutics and Clinical Risk Management

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ORIGINAL RESEARCH

Association of Perioperative Nursing Care with Incidence of Surgical Site Infections and Short-Term Outcomes in Primary Liver Cancer Patients: A Retrospective Comparison with Standard Care

Bin Yang[1], Xiaoyun Guo[1], Kewen Qi[1], Shaolong Sun[2]

[1]Department of Operating Room, Shengjing Hospital of China Medical University, Shenyang, Liaoning, 110004, People's Republic of China;
[2]Department of General Surgery,Shengjing Hospital of China Medical University, Shenyang, Liaoning, 110004, People's Republic of China

Correspondence: Shaolong Sun, Department of General Surgery, Shengjing Hospital of China Medical University, No. 36, Sanhao Street, Shenyang, Liaoning, 110004, People's Republic of China, Tel +86-024-96615-68801, Email sunsl@sj-hospital.org

Background: Surgical site infections (SSIs) are a significant complication following liver surgery (LS) for primary liver cancer (PLC), contributing to increased morbidity, prolonged hospital stays, and higher healthcare costs. This study aimed to evaluate the association of perioperative nursing care (PNC) with the incidence of SSIs and short-term outcomes, comparing patients receiving structured PNC to those receiving standard care.
Methods: A retrospective study was conducted at [specific location] between January 2016 and February 2019. A total of 360 PLC patients undergoing LS were included and divided into an observation group (PNC) and a control group (standard care). Outcome measures included SSI incidence, length of hospital stay, and independent predictors of SSIs. Logistic regression analysis was used to identify significant factors.
Results: Among the 360 included PLC patients, 180 received PNC while 180 did not. Patients in the PLC group had a significantly lower incidence of SSIs (28.3% vs 47.2%, P = 0.026) and shorter hospital stays (median: 8.2 vs 13.3 days, P = 0.049) compared to the control group. Multivariate logistic regression identified PNC as a significant protective factor against SSIs (OR = 2.01, 95% CI: 1.08–3.85, P = 0.031). Other significant predictors included education level (college or above: OR = 0.44, 95% CI: 0.24–0.79, P = 0.006) and comorbidities (more than two: OR = 2.21, 95% CI: 1.31–3.76, P = 0.003).
Conclusion: PNC emerged as an independent risk factor for SSIs in PLC patients undergoing LS. Thus, the provision of PNC is crucial for reducing the risk of SSIs and improving short-term outcomes in PLC patients undergoing LS.
Keywords: perioperative nursing care, PNC, surgical site infections, SSIs, primary liver cancer, PLC, liver surgery, LS

Introduction

Primary liver cancer (PLC) is a formidable global health concern, representing a major cause of cancer-related mortality worldwide.[1] Among the available treatment modalities, surgical intervention remains the cornerstone for achieving curative outcomes in eligible patients.[2] The complex nature of PLC necessitates a comprehensive approach that encompasses not only tumor excision but also patient-centered perioperative care (PNC) to optimize outcomes. Unlike the traditional disease-centered nursing mode, which focuses primarily on managing the disease with standardized protocols, PNC adopts a holistic, patient-centered approach.[3] PNC emphasizes individualized care, preoperative optimization, infection prevention strategies, and postoperative rehabilitation tailored to each patient's specific needs. Previous studies have demonstrated the advantages of PNC over traditional nursing models. For example, PNC has been shown to significantly reduce the incidence of surgical site infections (SSIs), improve patient satisfaction, and shorten hospital

Received: 23 December 2024
Accepted: 17 February 2025
Published: 17 March 2025

stays in various surgical settings. These findings underscore the importance of adopting PNC to address complications like SSIs and enhance recovery outcomes in liver surgery patients.[4] Understanding the relationship between perioperative nursing care[5] (PNC) and the incidence of SSIs is crucial in improving patient safety and short-term prognosis.

SSIs is a formidable concern in the field of surgical oncology, including liver surgery (LS) for PLC.[6] The occurrence of SSIs not only poses immediate challenges in terms of patient discomfort, prolonged hospital stays, and increased healthcare costs but also has far-reaching consequences, such as delayed wound healing, compromised immune response, and even long-term adverse effects on patient survival.[7] With PLC surgeries becoming more frequent, the incidence of SSIs demands meticulous attention and targeted interventions. Recognizing the impact of SSIs on patients' outcomes, it is imperative to thoroughly investigate the risk factors and potential preventive measures associated with this complication to minimize its occurrence and subsequent impact on short-term prognosis.

In the realm of LS for PLC, PNC plays a pivotal role in ensuring optimal patients' outcomes.[8] The perioperative period encompasses preoperative, intraoperative, and postoperative phases, and each phase presents unique opportunities to address patient-specific needs and mitigate potential complications.[9] PNC encompasses a multidimensional approach, including patient education, preoperative optimization, infection prevention strategies, intraoperative monitoring, and postoperative surveillance.[10] The importance of such care cannot be overstated, as it not only contributes to reducing the incidence of SSIs but also promotes enhanced patient recovery, overall well-being, and improved short-term prognosis.[11] Understanding the significance of PNC in LS for PLC is essential for healthcare professionals to adopt evidence-based practices and optimize patients' outcomes.

In the present study, we aimed to investigate the association between PNC and the incidences of SSIs, short-term outcomes in patients with PLC after LS with R0 status.

Materials and Methods

Study Design

This retrospective investigation included a continuous series of PLC patients who underwent LS as their primary treatment between January 2016 and February 2019 at the Shengjing Hospital of China Medical University. The presence or absence of perioperative nursing care (PNC) was determined based on the documented records in the hospital's electronic medical system. Patients in the PNC group received comprehensive perioperative care that adhered to institutional protocols, including preoperative education, intraoperative monitoring, and postoperative wound care. In contrast, the non-PNC group consisted of patients who received standard care, which primarily focused on basic clinical management without tailored perioperative interventions.The study adhered to the principles outlined in the Declaration of Helsinki and received ethical clearance from the Institutional Ethics Committees of Shengjing Hospital of China Medical University[SJ-2023021344]. Informed consent was obtained from each participant. To protect patient confidentiality, all identifying information was anonymized and replaced with surrogate identifiers.

Criteria for Patient Selection

To determine eligibility, participants had to meet the following requirements: (I) age of 18 years or older at the time of enrollment; (II) a provisional diagnosis of PLC confirmed by clinical evaluation; (III) no prior diagnoses of other cancers or history of major abdominal surgeries; (IV) early or intermediate-stage PLC (BCLC stages 0, A, or B) identified through physician assessment, with a Child-Pugh score of ≤7 indicating preserved liver function; and (V) comprehension of the study objectives and provision of informed consent to take part in the research.

The study also defined specific criteria for exclusion to maintain data integrity and reliability: (I) presence of metastatic liver cancer; (II) absence of critical data, including demographic details, clinical indicators, or follow-up information; and (III) withdrawal from the study, either by the patient's decision or at the request of their family.

The selection process for patients from the electronic medical records was conducted in three stages. First, all patients diagnosed with PLC and treated with LS during the study period were identified. Second, patients were screened based on the eligibility criteria described earlier, which included age, PLC diagnosis, liver function assessment, and consent for participation. Finally, patients were grouped based on the presence or absence of PNC. Equal numbers (n=180 in each group) were achieved by systematically matching patients using propensity score matching based on age, sex, comorbidities, and tumor stage to minimize selection bias.

Diagnostic Standard of PLC

The diagnosis of PLC and disease staging, based on the AASLD guidelines and BCLC framework, were prerequisites for patient eligibility in this study. While the diagnostic workup was conducted by the medical team, its relevance to PNC lies in the coordination and preparation of patients for surgery, including patient education and optimization, which are integral components of the PNC protocol. Here are several methods helpful for diagnosis of PLC:

(1) Imaging Modalities: Imaging techniques such as ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI) play a crucial role in the diagnosis of PLC. These imaging modalities help visualize and characterize liver lesions, assess tumor size, location, and extent, and identify any associated vascular involvement.
(2) Serum Alpha-Fetoprotein (AFP) Levels: AFP is a tumor marker commonly used in the diagnosis of PLC. Elevated AFP levels in the blood can indicate the presence of liver tumors, although it is important to note that not all cases of PLC exhibit increased AFP levels.
(3) Biopsy and Histopathological Examination: A definitive diagnosis of PLC often requires a tissue biopsy, where a sample of the liver tumor is obtained for histopathological examination. This procedure helps determine the specific type and grade of the tumor, as well as its differentiation status.
(4) Non-Invasive Biomarkers: Emerging non-invasive biomarkers, such as circulating tumor DNA (ctDNA) and microRNAs, are being investigated for their potential diagnostic utility in PLC. These biomarkers can be detected through blood tests and may offer additional diagnostic information.

Procedure of LS

While the surgical procedure, including liver resection with R0 status, refers to a complete tumor resection with negative margins under microscopic examination. Achieving R0 resection is critical for ensuring curative outcomes in liver surgery and is a key objective of surgical intervention for primary liver cancer. Specifically, PNC supported the procedure through intraoperative monitoring, infection prevention strategies, and immediate postoperative management. The Pringle maneuver, routinely applied during surgery, is briefly mentioned for completeness but is not directly relevant to the PNC interventions. These patients had tumors that were technically feasible to remove based on imaging studies, and they possessed sufficient remaining liver volume and functional capacity.

Perioperative Nursing Care and Management

- The group receiving PNC underwent structured perioperative interventions, encompassing preoperative, intraoperative, and postoperative phases. These interventions were distinct from the standard care provided to the non-PNC group, which primarily involved routine clinical management. The specific measures provided to the PNC group were as follows: Preoperative Evaluation and Optimization: For the PNC group, preoperative evaluation and optimization were conducted in the hospital's perioperative care unit. This included comprehensive assessments of the patient's overall health, liver function, and comorbidities. Interventions such as nutritional support, management of chronic conditions (eg, diabetes or hypertension), and patient education were implemented to minimize perioperative complications. The non-PNC group did not receive these structured interventions.Infection Prevention Strategies: The PNC group received enhanced infection prevention measures, including preoperative skin preparation with antiseptic solutions, proper sterilization of surgical instruments, and administration of antibiotic prophylaxis before surgery. While the non-PNC group followed routine infection control protocols, these were less comprehensive compared to the tailored measures provided to the PNC group.Intraoperative and Postoperative Management:: Intraoperative care in the PNC group included close coordination with surgeons to monitor patient status and adherence to strict aseptic techniques. Postoperatively, the PNC group underwent structured wound surveillance, early mobilization, and tailored follow-up care to monitor for surgical site infections (SSIs). In contrast, the non-PNC group received basic postoperative care without structured monitoring or follow-up protocols.

- Follow-up Procedures: Patients were followed up through outpatient visits and phone consultations at 1, 3, and 6 months postoperatively. Any loss to follow-up due to mortality or other reasons was documented. The time difference between surgeries and data collection ranged from 1 to 3 years.
- Classification of SSIs: SSIs were categorized into superficial SSI, deep SSI, and organ/space SSI according to global guidelines. Outcomes, including incisional and pulmonary infections, were tracked and analyzed for both groups, with specific attention to differences in the incidence rates and severity of infections.

By emphasizing the importance of a well-defined surgical procedure and comprehensive perioperative management, healthcare professionals can optimize patient outcomes, reduce the incidence of SSIs, and improve the short-term prognosis after LS for PLC.

Definitions

Patients with other diseases meant patients who had hypertension, diabetes, hyperlipidemia, obesity and so on except for PLC. SSIs were diagnosed based on clinical signs (redness, swelling, purulent discharge), microbiological culture results, and imaging findings. Treatment protocols included antibiotic therapy and surgical drainage when necessary. Operative time was defined as the duration from the first incision to the final dressing being placed on the patient. Hospitalization was defined as the process of admitting a patient to a hospital for medical care and treatment. Incision abscess, known as a type of SSIs that occurs as a result of bacterial contamination and subsequent colonization within the incision site.

Outcome Measures

The primary endpoint was SSIs. The secondary endpoints were surgery-related parameters, postoperative length of hospital stay and complications.

Collected Data

Collected variables included demographic characteristics (age, sex), socioeconomic factors (education level, household income), medical history (comorbidities, previous knowledge about PLC), and clinical features (incision abscess, pulmonary or abdominal infections). All collected data were reviewed and checked by the Supervisor and Principal Investigator for completeness and consistency. In cases of missing information, cross-referencing with patient records was conducted to ensure data accuracy and mitigation of gaps.

Statistical Analysis

For continuous variables, data were reported as either mean ± standard deviation (SD) or median accompanied by interquartile range (IQR), depending on the data characteristics. The unpaired two-tailed *t*-test was utilized for normally distributed data, while the Mann–Whitney *U*-test was applied for non-parametric data comparisons. Categorical data were expressed in terms of absolute frequencies and percentages (%), with group differences evaluated using either the chi-squared (χ^2) test or Fisher's exact test based on suitability. Variables demonstrating statistical significance in the univariate analysis were further examined through multivariate logistic regression. To pinpoint independent predictors of surgical site infections (SSIs), a backward stepwise likelihood ratio (LR) method was implemented in constructing the multivariate model, using a criterion of $P<0.05$ for variable inclusion in the final analysis. Hazard ratios (HRs) and their corresponding 95% confidence intervals (CIs) were calculated to quantify the strength and direction of associations between predictive factors and SSI risk. All statistical evaluations adhered to a two-sided testing framework, with a significance threshold established at $P<0.05$. Data analysis and modeling were performed using SPSS software, version 26.0, developed by SPSS Inc., based in Chicago, Illinois, USA.

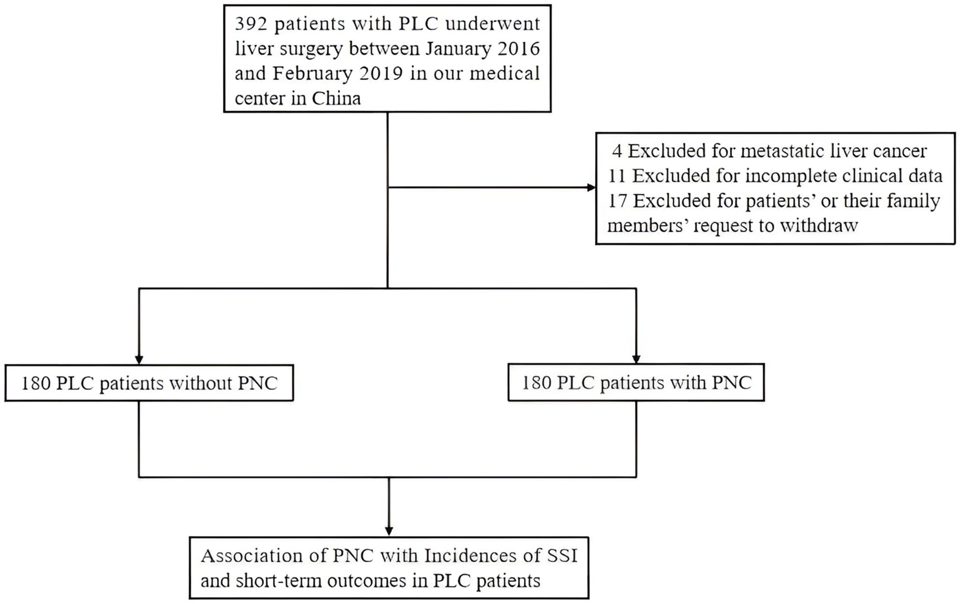

Figure 1 Patient Inclusion and Exclusion Flowchart.

Results

Baseline Characteristics of PLC Patients

Figure 1 illustrates that 392 patients diagnosed with PLC underwent liver surgery (LS) at our hospital during the study period. After excluding 32 patients who did not meet the study criteria, a total of 360 patients were included in the analysis. Among them, 180 patients received perioperative nursing care (PNC) and were categorized as the observation group, while the remaining 180 patients received standard care and were categorized as the control group. The median age of the included patients was 59.6 years (interquartile range: 51.4–68.2), with the PNC group having a slightly higher median age compared to the control group (63.0 years vs 56.0 years, P = 0.134). Male patients constituted the majority in both groups (78.9% in the PNC group vs 75.6% in the control group, P = 0.594). Surgical site infections (SSIs) were observed in 136 patients (37.8% overall), with a significantly lower incidence in the PNC group compared to the control group (28.3% vs 47.2%, P = 0.026). Regarding the types of SSIs, superficial SSIs accounted for 45 cases (12.5%), deep SSIs for 56 cases (15.6%), and organ/space SSIs for 35 cases (9.7%). Patients with SSIs had significantly longer hospital stays compared to those without SSIs (14.5 days vs 8.7 days, P < 0.001) (Table 1).

Table 1 The Baseline Clinicopathological Features of All PLC Patients (n = 360)

Variables	With PNC (n=180)	Without PNC (n=180)	*P*
Age, years	63.0 (52.2–70.8)	56.0 (48.0–64.0)	0.134
Sex, n (%)			0.594
Male	142 (78.9)	136 (75.6)	
Female	38 (21.1)	44 (24.4)	
Residential location, n (%)			0.124
City	122 (67.8)	102 (56.7)	
Village	58 (32.2)	78 (43.3)	
Education level, n (%)			0.187
Primary school	20 (11.1)	32 (17.8)	
Junior high school	52 (28.9)	66 (36.7)	
Senior high school	64 (35.6)	56 (31.1)	
College or above	44 (24.4)	26 (14.4)	

(*Continued*)

Table 1 (Continued).

Variables	With PNC (n=180)	Without PNC (n=180)	*P*
Working status, n (%)			0.092
Employed	142 (78.9)	122 (67.8)	
Others	38 (21.1)	58 (32.2)	
Household's average monthly income, n (%)			0.429
<1000 yuan (About USD160)	12 (6.7)	20 (11.1)	
1000–3000 yuan	84 (46.7)	96 (53.3)	
3000–5000 yuan	62 (34.4)	48 (26.7)	
>5000 yuan	22 (12.2)	16 (8.9)	
With other diseases, n (%)			0.222
No	26 (14.5)	30 (16.7)	
1–2 type	112 (62.2)	126 (70.0)	
More than 2 types	42 (23.3)	24 (13.3)	
Previous knowledge about PLC, n (%)			0.562
Low	88 (48.9)	102 (56.7)	
Moderate	76 (42.2)	66 (36.7)	
High	16 (8.9)	12 (6.6)	
SSIs, n (%)			0.026
Absent	129 (71.7)	95 (52.8)	
Present	51 (28.3)	85 (47.2)	
Operation time, min	167 (115–230)	173 (135–226)	0.523
Hospitalization, days	8.2 (5.5–12.5)	13.3 (9.2–16.0)	0.049
Incision abscess, n (%)	58 (32.2)	68 (37.8)	1.000
Pulmonary/Abdominal infection, n (%)	56 (31.1)	80 (44.4)	0.091

Abbreviations: PLC, primary liver cancer; PNC, perioperative nursing care; SSIs, surgical site infections.

Univariate Logistic Regression Analysis of SSI Incidence

Table 2 presents the univariate logistic regression analysis identifying factors associated with the incidence of SSIs. Patients in the PNC group had significantly lower odds of developing SSIs compared to the non-PNC group (OR = 1.89, 95% CI: 1.08–3.41, P = 0.030). Education level was inversely associated with SSIs, with patients having a college-level education or above showing a reduced risk (OR = 0.43, 95% CI: 0.25–0.71, P = 0.001). Similarly, higher household incomes (>5000 yuan) were associated with a reduced risk of SSIs (OR = 0.58, 95% CI: 0.37–0.89, P = 0.015). The presence of more than two comorbidities significantly increased the risk of SSIs (OR = 2.39, 95% CI: 1.48–3.90, P < 0.001). Additionally, incision abscesses were identified as a significant risk factor (OR = 1.56, 95% CI: 1.03–2.39, P = 0.038). These results highlight the protective role of PNC and other socioeconomic and clinical factors in reducing SSI risk.

Table 2 Univariate Analysis for the Incidence of SSIs in PLC Patients (n = 360)

Variables	B	SE	P Value	HR	HR (95% CI)
Age	−0.005	0.008	0.535	0.99	0.98–1.01
Sex					
Female					
Male	0.027	0.267	0.918	1.03	0.61–1.73
PNC					
Yes					
No	0.636	0.293	0.030	1.89	1.08–3.41
Residential location					
Village					
City	0.180	0.243	0.459	0.83	0.75–1.94

(*Continued*)

Table 2 (Continued).

Variables	B	SE	P Value	HR	HR (95% CI)
Education level					
Primary school					
Junior high school	−0.207	0.332	0.532	0.81	0.42–1.55
Senior high school	−0.113	0.164	0.492	0.89	0.65–1.23
College or above	−0.844	0.263	0.001	0.43	0.25–0.71
Working status					
Employed					
Others	−0.301	0.461	0.513	0.74	0.29–1.80
Household's average monthly income					
<1000 yuan (About USD160)					
1000–3000 yuan	0.141	0.594	0.812	0.87	0.36–3.95
3000–5000 yuan	0.374	0.352	0.289	0.69	0.74–2.97
>5000 yuan	−0.551	0.226	0.015	0.58	0.37–0.89
With other diseases					
No					
1–2 type	0.413	0.258	0.011	1.51	0.91–2.51
More than 2 types	0.873	0.247	<0.001	2.39	1.48–3.90
Previous knowledge about PLC					
Low					
Moderate	−0.006	0.205	0.977	0.99	0.66–1.49
High	−0.318	0.335	0.034	0.73	0.37–1.39
Operation time, min	−0.204	0.222	0.358	0.82	0.53–1.26
Hospitalization, days	−0.637	0.395	0.107	0.53	0.23–1.12
Incision abscess	0.447	0.216	0.038	1.56	1.03–2.39
Pulmonary/Abdominal infection	0.139	0.240	0.563	1.15	0.72–1.85

Abbreviations: SSIs, surgical site infections; PLC, primary liver cancer; PNC, perioperative nursing care.

Multivariate Logistic Regression Analysis of SSI Incidence

Table 3 outlines the results of the multivariate logistic regression analysis, which identified independent predictors for the incidence of SSIs. PNC was a significant protective factor, with patients in the PNC group having lower odds of SSIs compared to those in the non-PNC group (OR = 2.01, 95% CI: 1.08–3.85, P = 0.031). Other independent predictors included education level, where patients with college-level education or above demonstrated a significantly reduced risk of SSIs (OR = 0.44, 95% CI: 0.24–0.79, P = 0.006). Household income greater than 5000 yuan also emerged as

Table 3 Multivariate Logistic Regression Analysis for the Incidence of SSIs in PLC Patients (n = 360)

Variables	B	SE	P Value	HR	HR (95% CI)
PNC					
Yes					
No	0.697	0.324	0.031	2.01	1.08–3.85
Education level					
Primary school					
Junior high school	−0.211	0.320	0.418	0.79	0.41–1.57
Senior high school	−0.115	0.159	0.582	0.84	0.63–1.28
College or above	−0.813	0.298	0.006	0.44	0.24–0.79

(*Continued*)

Table 3 (Continued).

Variables	B	SE	P Value	HR	HR (95% CI)
Household's average monthly income					
<1000 yuan (About USD160)					
1000–3000 yuan	1.116	0.824	0.200	0.33	0.72–1.30
3000–5000 yuan	0.667	0.276	0.160	0.51	0.30–0.88
>5000 yuan	0.920	0.334	0.006	0.40	0.21–0.76
With other diseases					
No					
1–2 type	0.420	0.279	0.130	1.52	0.88–2.64
More than 2 types	0.792	0.269	0.003	2.21	1.31–3.76
Previous knowledge about PLC					
Low					
Moderate	−0.474	0.246	0.054	0.62	0.38–1.01
High	−0.318	0.335	0.034	0.73	0.37–1.39
Incision abscess	0.767	0.246	0.002	2.15	1.33–3.51

Abbreviations: SSIs, surgical site infections; PLC, primary liver cancer; PNC, perioperative nursing care.

a protective factor (OR = 0.40, 95% CI: 0.21–0.76, P = 0.006). Conversely, the presence of more than two comorbidities (OR = 2.21, 95% CI: 1.31–3.76, P = 0.003) and incision abscess (OR = 2.15, 95% CI: 1.33–3.51, P = 0.002) significantly increased the risk of SSIs. In the multivariate analysis, patients with high previous knowledge about PLC were associated with a reduced risk of SSIs (OR = 0.73, 95% CI: 0.37–1.39, P = 0.034). This finding suggests that patient education may play a role in SSI prevention, likely due to better adherence to postoperative care instructions and increased awareness of infection warning signs. These findings underscore the importance of PNC and other socioeconomic and clinical factors in reducing SSI risk and improving postoperative outcomes.

Discussion

This study demonstrated that structured perioperative nursing care (PNC) significantly reduced the incidence of surgical site infections (SSIs) and improved short-term outcomes in primary liver cancer (PLC) patients undergoing liver surgery (LS). Key findings included a lower SSI rate in the PNC group compared to the non-PNC group (28.3% vs 47.2%) and shorter hospital stays (median: 8.2 days vs 13.3 days). PNC, education level, household income, and comorbidities were identified as significant predictors of SSIs, with PNC emerging as a protective factor. As PLC remains a significant global health concern, surgical resection continues to be a cornerstone in its management, aiming to achieve curative outcomes and improve patient survival.[12,13] However, SSIs remain a major challenge following LS, contributing to substantial morbidity, prolonged hospital stays, and increased healthcare costs.[14] These findings provide new insights into the critical role of PNC in addressing these challenges and optimizing patient outcomes by mitigating the risk of SSIs and enhancing recovery.

Our findings demonstrated that structured PNC interventions significantly reduced the incidence of SSIs and improved short-term outcomes, including shorter hospital stays. The PNC group benefited from comprehensive measures such as preoperative optimization (nutritional support, comorbidity management, and patient education), intraoperative infection prevention strategies (strict aseptic techniques, appropriate antibiotic prophylaxis), and postoperative wound surveillance and early mobilization. These targeted nursing interventions likely mitigated the risk of bacterial colonization and systemic complications, contributing to the observed improvements in patient recovery and reduced SSI-related complications.[15,16] SSIs are among the most common and potentially serious complications of LS, with profound impacts on patient well-being and prognosis. Beyond physical discomfort and pain, SSIs exacerbate systemic inflammatory responses, delay wound healing, and heighten the risk of secondary complications such as intra-abdominal abscesses or sepsis. These complications further compromise recovery and, in severe cases, can result in mortality.[17,18] Our findings underscore the critical role of preventive measures in addressing these risks, highlighting the value of integrating comprehensive PNC into standard surgical care protocols.

This study adds to the growing body of evidence that perioperative nursing interventions play a pivotal role in enhancing surgical outcomes. Perioperative nurses, by adhering to evidence-based practices and maintaining strict aseptic techniques, are instrumental in reducing SSI risk and promoting patient education. These measures empower patients to adhere to postoperative care instructions, facilitating early detection and management of potential complications.[19,20] Importantly, our results align with the broader objectives of improving patient safety, optimizing surgical outcomes, and enhancing the overall quality of perioperative care.[21,22] By bridging the gap between nursing care and surgical outcomes, our findings provide actionable insights for healthcare providers seeking to improve recovery trajectories for PLC patients undergoing LS. Future research should explore the scalability of these PNC interventions across diverse clinical settings and investigate their long-term impact on patient outcomes and healthcare resource utilization.In this study, patients with PLC who did not have PNC experienced a notably higher rate of SSIs compared to those with PNC. Both univariate and multivariate analyses identified PNC as an independent risk factor for the development of SSIs. PLC patients with PNC had a markedly shorter length of hospital stay compared to those without PNC. Additionally, college or above education level, household's average monthly income > 5000 yuan, with more than 2 types diseases, high previous knowledge about PLC, and incision abscess were also independent risk factors of the incidence of SSIs. Taken together, the lower the education level, the less the monthly income, the more complicated with many other diseases, the moderate or low understanding of PLC and the abscess of incision, the more the PNC is needed.

SSIs remain the most common postoperative complication, with far-reaching consequences such as increased morbidity, extended hospital stays, readmissions, and even sepsis or mortality, imposing significant physical and economic burdens on patients.[23,24] Addressing these challenges is crucial for improving patient outcomes and reducing healthcare costs. Recent evidence also highlights the potential of Butyrylcholinesterase (BuChE) levels as a predictive marker for complications following liver surgery, providing a promising tool for identifying at-risk patients and guiding perioperative management.[25] Furthermore, advances in artificial intelligence (AI) and image processing have revolutionized the diagnosis, treatment, and prognosis of liver cancer. AI-based tools enable earlier detection and personalized treatment strategies, which could significantly enhance clinical outcomes. These technologies, by complementing traditional approaches, open new avenues for improving liver cancer management.[26]

Our study has some important limitations. One key limitation is its retrospective nature, which introduces potential selection bias and other inherent flaws. Additionally, since the study encompassed all PLC patients, the findings may not be broadly applicable to other patient populations. PLC can be divided into hepatocellular carcinoma, cholangiocarcinoma and mixed liver cancer, and the surgical effects of different kinds of liver cancer are also different. Whether the results of this study can be accurately determined to a certain type of PLC needs further verification. Third, the beneficial effect of PNC on SSIs of PLC patients may also be associated with other compound factors, because of the different skills and measures of nurses in PNC. Fourth, surgeons operating on patients with PNC were different, and their surgical skills were also different. Finally, inflammatory indicators related to SSIs have not been further explored in this study. Some specific data on how to cope with patients with SSIs were incomplete, so we cannot add the nursing intervention measures for patients with SSIs into our study.

Conclusions

In conclusion, the findings of the present study demonstrated that PLC patients without PNC had a significantly higher incidence of SSIs and a longer length of hospital stay compared to those with PNC. PLC patients with PNC had a low proportion of postoperative short-term complications than patients without PNC after LS with R0 status, although the difference is not significant. In the future, a prospective controlled trial is recommended to validate the relationship between PNC and the incidence of SSIs in PLC after LS.

Data Sharing Statement

The datasets used and analyzed in this study are available and can be obtained from the corresponding author on reasonable request.

Ethics

This research approved by the Ethics Committee of Shengjing Hospital of China Medical University.

Consent for Publication

Written informed consent for publication was obtained from the patients and/or their legal guardians for publication.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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