Journal of Pain Research

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

Construction of Pain Management Strategies After Hepatectomy: Evidence Summary and Delphi Study

Yuqin Wang[1], Xiuxiu Song[1], Siqi Wang[2], Ting Bai[3], Rui Li[3], Haonan Liu[4], Yuping Liu[3], Zhengxiang Han[4]

[1]Department of General Surgery, The Affiliated Hospital of Xuzhou Medical University, Xuzhou, Jiangsu Province, People's Republic of China; [2]Xuzhou Medical University, Xuzhou, Jiangsu Province, People's Republic of China; [3]Nursing Department, The Affiliated Hospital of Xuzhou Medical University, Xuzhou, Jiangsu Province, People's Republic of China; [4]Department of Oncology, The Affiliated Hospital of Xuzhou Medical University, Xuzhou, Jiangsu Province, People's Republic of China

Correspondence: Zhengxiang Han; Yuping Liu, The Affiliated Hospital of Xuzhou Medical University, No. 99 huaihai West Road, Quanshan District, Xuzhou City, Jiangsu Province, People's Republic of China, Email cnhzxyq@163.com; 1647221333@qq.com

Purpose: To develop and summarize pain management strategies after hepatectomy for liver cancer based on the best evidence summary, and to improve the strategy of the Delphi study.

Methods: According to the "6S" evidence pyramid model, the database was systematically searched, with a search deadline of December 2023. Two researchers independently conducted literature screening and quality evaluation. Relevant evidence on pain management was extracted and integrated. Relevant evidence for pain management formed a preliminary strategy through a one-day, face-to-face meeting. Subsequently, a Delphi process was performed to improve the strategy. The scientific soundness of the Delphi method was expressed by the effective response rate, authority coefficient (Cr), and coordination coefficient. The coordination of expert opinions was assessed using the coefficient of variation (CV) and Kendall's coefficient (W). Cr should be above 0.700 and the coefficient of variation (CV) should be below 0.25. Data analysis was performed using SPSS V.25.0.

Results: A total of 14 studies were included, and we summarized 13 first-level items and 48 second-level items by two rounds of Delphi. The effective response rate of the two rounds of Delphi was 100.00%, and the authority coefficient of the experts was 0.832. The coefficients of variation were 0.00–0.41 and 0.05–0.17, respectively. The Kendall's W values for the two rounds were 0.114–0.222 ($p<0.05$).

Conclusion: Pain management strategy after hepatectomy is scientific and applicable. We plan to translate this into a plan and confirm its feasibility in the future.

Keywords: pain management, hepatectomy, evidence-based nursing, Delphi method, liver cancer

Introduction

Liver cancer is one of the most common types of cancer in China. Hepatectomy is one of the important methods in the treatment of primary liver cancer and the most effective way to achieve long-term survival of liver cancer. Postoperative pain is one of the most common symptoms of patients after liver resection,[1] and study shown that about 76.6% of patients after liver resection experienced pain.[2] Postoperative pain leads to prolonged length of stay (LOS), affects sleep quality, induces anxiety, depression and other negative emotions, and has an adverse impact on recovery and quality of life.[3,4] Appropriate pain management is key to the success of the Enhanced Recovery After Surgery (ERAS) program in hepatectomy,[5,6] which can promote rapid recovery and reduce the occurrence of postoperative complications.

Current studies on pain management after hepatectomy include preventive analgesia, multimodal analgesia, optimization of pain assessment tools and intervention strategies, etc, but these measures are varied, uneven and scattered, and there is a lack of comprehensive and systematic guidance in clinical practice. Although some guidelines and expert

Received: 12 October 2024
Accepted: 17 December 2024
Published: 27 December 2024

consensus provide relevant pain management guidances, for example, in 2016, the American Academy of Pain Management and others developed clinical practice guidelines for postoperative pain management,[7] but it was uncertain whether this was applicable to patients after hepatectomy, and Chinese experts have reached a consensus on enhanced recovery after hepatectomy,[8] but pain management is less available and there are no specific recommendations. There is a lack of clear guidelines for pain management after hepatectomy for liver cancer. Therefore, this study summarized the existing evidence to identify the best strategy for pain management after hepatectomy, and provided a reference for scientific guidance in clinical nursing practice.

Methods

Evidence Summary

Problem Establishment

The research question was formulated according to the PIPOST model as follows: ①P (population): patients after hepatectomy; ②I (intervention): management measures to relieve pain; ③P (professional): surgeons, nurses, anesthesiologists, etc; ④0(outcome): level of pain, the effects of pain on mood and activity and satisfaction with pain control; ⑤S (setting): general surgery ward; and ⑥T(type of evidence): clinical decision-making, guidelines, evidence summaries, systematic reviews, and expert consensus.

This study has been registered and approved by the Evidence-Based Center of Fudan University, Shanghai (ES20245484).

Evidence Retrieval

According to the "6S" model, this study searched databases from inception to December 2023, including UpToDate, BMJ Best Practice, JBI, Registered Nurses' Association of Ontario (RNAO), National Comprehensive Cancer Network (NCCN), The European society of regional anesthesia &pain therapy(ESRA), Guidelines International Network(GIN), American Society of Regional Anesthesia and Pain Medicine (ASRA), the United States Association for the Study of Pain (USASP), Medical Pulse, Cochrane Library, Web of Science, PubMed, MEDLINE, Embase, China Biology Medicine (CBM), CNKI and Wanfang data, etc. The search was conducted using a combination of subject and free terms. The search terms used were liver resection, hepatic resection, hepatectomy, liver cancer, liver neoplasm, liver tumor, liver carcinoma, hepatic tumor, hepatic carcinoma, hepatocellular carcinoma, surgery, excision, operation, pain management, cancer Pain, pain nursing, and pain assessment. Using PubMed as an example, the corresponding search strategy was illustrated in Figure 1.

Inclusion and Exclusion Criteria of Evidences

The inclusion Criteria were as follows: (1) patients aged ≥18 years after hepatectomy; (2) study cohorts that involved pain assessment and management and other related measures; (3) literature types that included clinical decision-making, the latest versions of updated or revised guidelines, systematic reviews, evidence summaries, and expert consensus; and (4) publication language limited to Chinese and English.

Exclusion Criteria were as follows: (1) incomplete or unable to find through various methods; (2) studies with unsatisfactory quality evaluation; (3) direct translation or duplication; and (4) full literature that could not be obtained.

Literature Screening

EndNote was used to manage the literature and duplicate studies were excluded. Two researchers independently screened the literature based on inclusion and exclusion criteria. Two investigators read the title and abstract during the initial screening, excluded irrelevant literature, and read the full text for rescreening. If there were differences in the screening process, a third researcher was consulted to determine final inclusion criteria.

Quality Evaluation of the Literature

Two investigators trained in evidence-based medicine independently used appropriate assessment tools based on literature. If the literature evaluation levels differed, discussions were held with an expert trained in evidence-based medicine to determine the quality of the literature.

#1 Pain Management OR Pain, Postoperative OR Cancer Pain[MeSH Terms]

#2 Pain nursing OR Pain assessment[Title/Abstract]

#3 #1 OR #2

#4 Carcinoma, Hepatocellular/surgery OR Liver resection[MeSH Terms]

#5 Hepatic resection OR Hepatectomy OR Liver cancerOR Liver neoplasmOR Liver tumor OR Liver carcinoma OR Hepatic tumor OR Hepatic carcinoma OR Hepatocellular carcinoma OR Surgery OR ExcisionOR Operation[Title/Abstract]

#6 #4 OR #5

#7 #3 AND #6

Figure 1 Search strategy of PubMed.

The guidelines were evaluated using the Appraisal of Guidelines for Research and Evaluation II (AGREE II) system, which was updated in 2017 and includes 6 fields, 23 items, and 2 comprehensive evaluation items. Each item is scored from 1 to 7 (1 = strongly disagree, 7 = strongly agree). Standardized scores in each field = [(actual score evaluated − lowest possible score)/(highest possible score − lowest possible score)] × 100. The guidelines were divided into three grades according to the standardized scores (Grade A, ≥60% in six fields score; Grade B, ≥30% in ≥3 fields score, and some fields with scores <60%; and Grade C, <30% in ≥3 fields with scores <30%). The intraclass correlation coefficient (ICC) was used to assess the inter-rater consistency. Expert consensus was evaluated by the JBI Evidence-based Health Care Center (2017 Edition), including six items judged as yes, no, unclear, or not applicable.

Evidences Extraction and Gradation

Two researchers trained in evidence-based medicine and 10 years of work experience in general surgery independently extracted and integrated the content of the literature, which was then checked and verified by a third researcher. In the process of integration, consistent evidence was combined, and when there was a conflict between evidence from different sources, the principles of preserving different conclusions, prioritizing evidence-based evidence, prioritizing high-quality evidence, prioritizing the most recently published evidence, and prioritizing authoritative literature were followed.

Search Results and Quality Appraisals

Fourteen of the 13,094 literatures were included[5,7–19] (Figure 2 and Table 1), including seven guidelines and seven expert consensus. Figure 2 was flowchart of study selection and Table 1 was included study characteristics. Among the seven guidelines, six were grade B and one was grade A, and all of them are included. The ICC of the two researchers were 0.857, 0.950, 0.979, 0.937, 0.909, 0.976 and 0.781, respectively, with good consistency. Most of the items in the quality evaluation results of the seven expert consensus were ‘yes’, and only some items were “unclear” or “no”, so all of them were included. The evaluation results of the 14 literatures are presented in Table 2 and Table 3, respectively.

The Preliminary Strategy

Relevant interventions were extracted from 14 literatures, thus forming a pool of 62 evidence items (Table 4) and extracting 14 categories. A multidisciplinary panel of individuals with anesthesia, pain management, and surgical background was established. The panel was chaired by a nursing supervisor in general surgery, and ten experts were invited to attend a 1-day, face-to-face meeting aimed at translating evidence into the preliminary strategy.

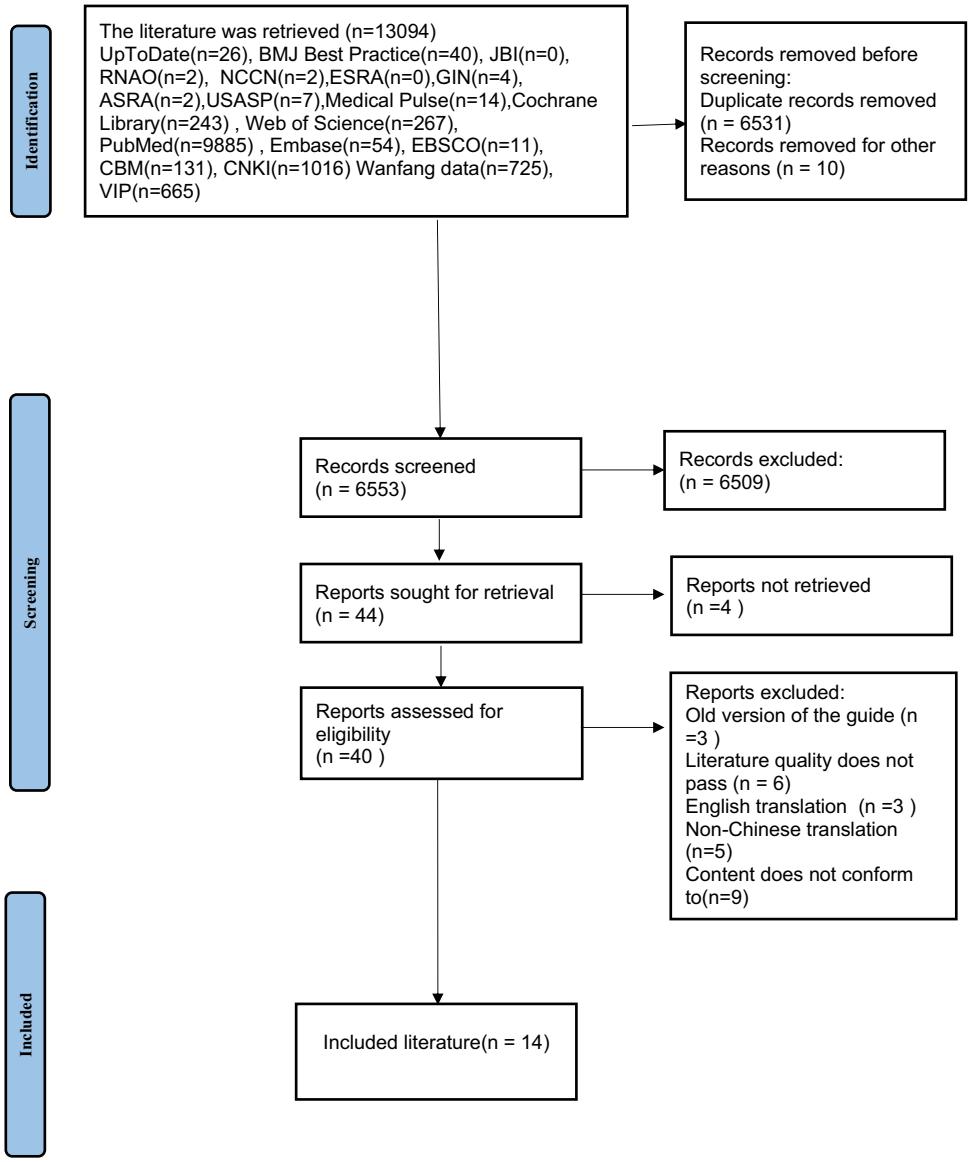

Figure 2 Flowchart of Study selection.

Delphi Study

A Delphi study was performed to drive the consensus of experts to improve the preliminary strategy. Before Delphi study, we obtained expert consent through online consent form, and clearly informed the purpose, content, privacy protection, voluntary participation and withdrawal freedom of research. Ensure that the process complied with ethical regulations, recorded the consent certificate, and provided the contact information of researchers.

Participants

The recommended number of experts is between 15 and 50,[20] and the conclusions drawn by the appropriate number of experts have a high degree of confidence. Experts are required to have at least 5 years of working experience in clinical, nursing, anesthesia and pain disciplines, and have a bachelor's degree or above. Those who cannot complete the whole consultation process will be excluded. Sixteen experts were selected for the study.

Table 1 Study Characteristics Arranged by Type of Literature

Included Literature	Year of Publication (year)	Literature Reference	Type of Literature	The Literature Theme	Publisher Platform
Omar A et al[14]	2023	PubMed	Guideline	Egyptian Society of Liver Cancer Recommendation Guidelines for the Management of Hepatocellular Carcinoma	Journal of Hepatocellular Carcinoma
National Health Commission of the People's Republic of China[11]	2022	Wanfang database	Guideline	Standardization for Diagnosis and Treatment of Primary Hepatic Carcinoma (2022 Edition)	Cancer Research on Prevention and Treatment
Coccolini F et al[19]	2022	PubMed	Guideline	Postoperative pain management in non-traumatic emergency general surgery: WSES-GAIS-SIAARTI-AAST guidelines	World Journal Emergency Surgery
Aubrun F et al[13]	2019	PubMed	Guideline	Revision of expert panel's guidelines on postoperative pain management	Anaesthesia, critical care & pain medicine
Cooney MF et al[15]	2016	PubMed	Guideline	Postoperative Pain Management: Clinical Practice Guidelines	Journal of perianesthesia nursing
Chou, R et al[7]	2016	PubMed	Guideline	Management of Postoperative Pain: A Clinical Practice Guideline From the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council	The journal of pain
RNAO[16]	2013	RNAO	Guideline	Assessment and Management of Pain (Third Edition)	Registered Nurses' Association of Ontario
Villegas Estévez F J et al[12]	2023	PubMed	Expert consensus	Procedural pain in patients with cancer: a Delphi expert management consensus	BMJ supportive & palliative care
Gu et al[9]	2021	CNKI	Expert consensus	Shanghai expert consensus on perioperative analgesia managment in general surgery patients (2020 edition)	Chinese Journal of Practical Surgery
Cancer Prevention and Treatment Expert Committee,Cross-Straits Medicine Exchange Association[17]	2021	Wanfang database	Expert consensus	Chinese expert consensus on the peri-operative management of hepatectomy for liver cancer (2021 Edition)	Chinese Journal of Oncology
Feng et al[10]	2017	CNKI	Expert consensus	The Expert consensus of Multidisciplinary management team for pain management	Journal of Clinical Anesthesiology
Xu et al[18]	2017	CNKI	Expert consensus	The Expert consensus of post-operative pain management in adults	Journal of Clinical Anesthesiology
Chen et al[8]	2017	Wanfang database	Expert consensus	Chinese expert consensus on enhanced recovery after hepatectomy (2017 Edition)	Chinese Journal of Hepatic Surgery
Leng et al[5]	2015	Wanfang database	Expert consensus	The Expert consensus of perioperative pain management in general surgery	Chinese Journal of General Surgery

https://doi.org/10.2147/JPR.S449243

https://doi.org/10.2147/JPR.S459243

Table 2 Quality Evaluation Results of Guidelines (N= 7)

Guideline	Standardized Scores in Various Domains (%)						≥60%	≥30%	ICC	Quality Evaluation
	Scope and Purpose	Stakeholder Involvement	Rigour of Development	Clarity of Presentation	Applicability	Editorial Independence				
Omar A et al[14] 2023	83.33	63.89	75.00	75.00	52.08	100.00	5	6	0.857	B
National Health Commission of the People's Republic of China[11] 2022	91.67	44.44	46.88	97.22	43.75	100.00	3	6	0.950	B
Coccolini F et al[19] 2022	97.22	69.44	80.21	94.44	43.75	100.00	5	6	0.979	B
Aubrun F et al[13] 2019	66.67	44.44	79.16	91.67	41.67	100.00	4	6	0.937	B
Cooney MF et al[15] 2016	75.00	50.00	78.13	91.67	35.42	100.00	4	6	0.909	B
Chou R et al[7] 2016	100.00	66.67	87.50	88.89	41.67	95.83	5	6	0.976	B
RNAO[16] 2013	100.00	97.22	96.88	100.00	87.50	100.00	6	6	0.781	A

Table 3 Quality Evaluation Results of Expert Consensus (N= 7)

Items	Villegas Estévez FJ. et al[12] 2023	Gu et al[9] 2021	Cancer Prevention and Treatment Expert Committee, Cross-Straits Medicine Exchange Association[17] 2021	Xu et al[18] 2017	Chen et al[8] 2017	Feng et al[10] 2017	Leng et al[5] 2015
1. Is the source of the opinion clearly identified?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Does the source of opinion have standing in the field of expertise?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Are the interests of the relevant population the central focus of the opinion?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Is the stated position the result of an analytical process, and is there logic in the opinion expressed?	Yes	Yes	Yes	Yes	Yes	Yes	Unclear
5. Is there reference to the extant literature?	Yes	Unclear	Yes	Yes	Yes	Yes	Unclear
6. Is any incongruence with the literature/sources logically defended?	No	Yes	Unclear	Yes	No	Yes	No

https://doi.org/10.2147/JPR.S494243

https://doi.org/10.2147/JPR.S494243

Table 4 Summary of Evidences for Pain Management Strategies After Hepatectomy

Items	$\bar{x} \pm s$	CV
1. Establish an Acute Pain Service Team(APST)	4.88±0.34	0.07
1.1 Establish an Acute Pain Service Team(APST), encompassing experts from specialties such as hepatology, pain management, surgery, nursing, oncology, pharmacy, pathology, and nutrition, etc.	4.75±0.58	0.12
1.2 Responsibilities of the APST: perioperative pain treatment, assessment of analgesic effects, management of adverse reactions, educating and dissemination, improving the comfort and satisfaction and reducing postoperative complications.	4.56±0.63	0.14
2. Pain Management Principles	4.81±0.40	0.08
2.1 Preventive Analgesia: preventive analgesia to reduce surgical stress responses and optimize pain control procedure.	4.63±0.72	0.16
2.2 Multimodal Analgesia: multimodal analgesia by analgesic methods to achieve excellent pain relief with the fewest adverse effects.	4.94±0.25	0.05
3. Pain Screening	4.75±0.45	0.09
3.1 Comprehensive screening of past medical history, surgical and treatment experiences, medication history, pain history, cognitive and psychological status.	4.69±0.60	0.13
3.2 Pay attention to the patient's response for analgesic medications (especially opioids), drug allergy and intolerances.	4.63±0.50	0.11
3.3 Assess the misuse, abuse, and addiction of medications.	4.19±0.98	0.23
4. Make management plan	4.81±0.40	0.08
4.1 Based on the pain screening and treatment objectives, develop a pain management plan.	4.81±0.54	0.11
4.2 Encourage patient to participate in pain management plan, reflecting their preferences and expectations.	4.44±0.89	0.20
4.3 Adjust the pain management plan dynamically based on the result of pain assessment.	4.69±0.60	0.13
5. Time for assessment	4.94±0.25	0.05
5.1 Pain assessment immediately after the surgery.	4.69±0.60	0.13
5.2 Dynamic monitoring of pain: every 2 hours within 6 hours, every 4 hours within 6 to 24 hours, and every 12 hours after 24 hours.	4.75±0.58	0.12
5.3 For stable pain patients, reduce the frequency of pain evaluation.	4.38±0.81	0.18
5.4 The analgesic effect was evaluated when it reached the peak, which is typically 15 to 30 minutes after parenteral administration and 1 to 2 hours after oral administration.	4.94±0.25	0.05
5.5 For the use of patient-controlled analgesia (PCA), continuously need to monitor and assess the number of ineffective button presses.	4.63±0.62	0.13
5.6 Immediately assess the effectiveness after implementing non-drug interventions.	4.50±0.89	0.20
5.7 Assess pain score at rest.	4.63±0.62	0.13
5.8 Assess pain score during periods of movement or activity, such as walking, sitting up.	4.56±0.73	0.16
5.9 Anesthesiology medical staff should visit the patients with pain at least once a day.	4.56±0.63	0.14
6. Evaluation Tools	4.69±0.60	0.13
6.1 Select appropriate validated pain assessment tool based on the patient's age and cognitive-communication performance, such as the Numerical Rating Scale (NRS) or the Visual Analog Scale (VAS).	5.00±0.00	0.00
6.2 For children, patients with language barriers, or those who cannot self-report, choose appropriate assessment tools such as the Wong-Baker Faces Pain Scale Revision (FPS-R), Behavioral Assessment Scale, etc.	5.00±0.00	0.00
6.3 Emphasize the patient self-report is the primary basis of all pain assessments.	4.75±0.77	0.16
6.4 Encourage patients to report pain experiences, including the intensity, quality, onset time, duration of the pain, and impact on daily activities.	4.75±0.58	0.12

7. Assessment Content	4.88±0.50	0.10
7.1 Assess the patient's pain characteristics, including intensity, cause, type (such as neuropathic, visceral, somatic, muscle spasm), and how it affects function and vital sign changes.	4.81±0.40	0.08
7.2 Evaluate the effect of pain relief after the implementation of drug treatment or pain intervention measure.	4.88±0.50	0.10
7.3 Assess specific interventions have an effective effect on the pain.	4.56±0.63	0.14
7.4 Evaluate if there are any side-effects, such as nausea, vomiting, bowel dysfunction, urinary retention, pruritus.	4.63±0.62	0.13
8. Principles of Pain Intervention	3.63±1.50	0.41[a]
8.1 Drug and non-drug interventions should be tailored to the characteristics of the patient, care setting and procedure.	4.31±1.08	0.25[a]
8.2 Provide hierarchical management according to the pain level and choose appropriate analgesic methods.	4.31±1.08	0.25[a]
9. Drug Intervention	4.94±0.25	0.05
9.1 It is recommended that postoperative analgesia be based on continuous nerve block (psoas block, thoracic paravertebral block, and transversus abdominis plane block) or local anesthetic wound infiltration, combined with multimodal analgesia (intravenous NSAIDs and (or) low-dose opioid + antiemetic), covering more than 48–72 hours.	4.88±0.34	0.07
9.2 Multimodal analgesia is recommended to be based on nonsteroidal anti-inflammatory drugs and acetaminophen.	4.69±0.79	0.17
9.3 Consider the use of gabapentin or pregabalin as part of the multimodal analgesia.	4.44±0.73	0.16
9.4 Consider intravenous lidocaine in adults undergoing open and laparoscopic abdominal surgery.	3.81±1.12	0.37[a]
9.5 Consider intravenous injection of 8mg dexamethasone in adults.	3.75±1.53	0.41[a]
9.6 Avoid the use of analgesics via intramuscular injection.	4.44±1.96	0.22
9.7 It is suggested to use opioid therapy for moderate to severe postoperative pain, with oral administration as the first choice.	4.69±0.60	0.13
9.8 For patients receiving opioid analgesia, closely monitor assessments of alertness and signs or symptoms of hypoventilation or hypoxia.	4.75±0.58	0.12
10. Non-drug Intervention	4.56±0.73	0.16
10.1 Consider transcutaneous electrical nerve stimulation (TENS) as an adjunct to relieve pain.	4.75±0.58	0.12
10.2 Consider incorporate cognitive-behavioral patterns as part of multimodal approach.	4.44±0.81	0.18
10.3 Consider music therapy to relieve pain.	4.44±0.73	0.16
10.4 Consider pre-operative guided imagery and relaxation techniques.	4.38±0.62	0.14
11. Pain Record	4.69±0.60	0.13
11.1 Record the pain characteristics, including the intensity, cause and type (eg, neuropathic, visceral, somatic, muscle spasm) of pain, and how it affects function.	4.94±0.25	0.05
11.2 Record pain scores at rest and activity.	4.94±0.25	0.05
11.3 Record detailed pain management plans and specific goals, and promptly record the adjusted content.	4.56±1.03	0.23
11.4 Record the changes in vital signs before and after analgesia, the effectiveness of analgesia, the treatment method and outcomes of adverse reactions.	4.88±0.34	0.07
11.5 It is suggested to use charts to record changes in postoperative pain intensity, forming a pain relief curve, and mark key information such as the timing of analgesic interventions, drug dosages, and changes in vital signs.	4.56±0.73	0.16
12. Pain Assessment	4.88±0.34	0.07
12.1 Regularly evaluate the effectiveness of drugs or other pain treatment methods, as well as adverse reactions.	4.88±0.34	0.07
12.2 Evaluate the effectiveness of pain control and potential obstacles, such as drug dependence, side effects, adherence to medication and psychological state.	4.81±0.40	0.08
12.3 At the end of pain treatment, obtain feedback on the satisfaction of the medical staff's pain management through questionnaires or interviews.	4.38±0.62	0.14
12.4 Obtain the satisfaction of pain management process through questionnaires or interviews	4.56±0.51	0.11

(*Continued*)

https://doi.org/10.2147/JPR.S494243

https://doi.org/10.2147/JPR-S494243

Table 4 (Continued).

Items	$\bar{x} \pm s$	CV
13. Pain Education	4.50±0.73	0.16
13.1 health education are integrated from before admission to after discharge.	4.75±0.58	0.12
13.2 Provide personalized pain management education to patients and their families.	4.75±0.58	0.12
13.3 Explain the importance of postoperative pain management to the patient and their family before surgery, and introduce available analgesic methods.	4.75±0.45	0.09
13.4 Guide patients to use pain assessment tools and express their pain experience accurately.	4.81±0.40	0.08
13.5 Provide guidance on the use of analgesic drugs, including drug type, dosage, and potential side effects.	4.81±0.54	0.08
13.6 Provide pain management knowledge to patients and their families through various forms, such as face-to-face consultation, distribution of educational manuals, playing educational videos, providing audio materials, or online educational resources.	4.81±0.40	0.08
13.7 Introduce the postoperative pain management treatment plan to patients and their families, including drug therapy, physical therapy, etc.	4.44±0.89	0.20
13.8 Guide patients to participate in pain management actively, and provide pain relief strategies.	4.69±0.60	0.13
14. Risk Control	4.50±0.63	0.14
14.1 Identify potential complications and drug interaction based on the result of pain screening and assessment.	4.69±0.48	0.10
14.2 Monitor the sedation level and respiratory function of using opioid drugs, and identify risks such as excessive sedation and respiratory depression or other adverse complication.	4.75±0.45	0.09
14.3 Develop and implement emergency plans for excessive sedation, respiratory depression, and other adverse events to ensure that risks can be handled quickly and effectively.	4.63±0.62	0.13
14.4 Adjust the pain management plan on the basis of adequacy of pain relief and presence of adverse events.	4.69±0.60	0.13

Notes: a:CV≥0.25.

Delphi Survey Rounds

An internet survey was generated and sent to 16 members of the panel that involved areas of pain management, anesthesia, and general surgery.

In the first round, we administered a questionnaire consisting of three parts to each expert. The first part introduces the purpose, method, and significance of this research. The second part was a list of interventions that comprised the initial item pool, which was asked to rate importance using a Likert scale of 1–5(1-Not important to 5-Very important). There was a text column so that experts could write suggestions regarding the intervention. The third part was the expert situation questionnaire and the familiarity and judgment bases for the research questions.

Before the next round, some items were revised, excluded, or added based on the scores and opinions of experts and the statistical results of the first round. In the next round, updated consulting questionnaires were sent to experts, and the process was the same as in the first round.

Data Analysis

All data were first sorted and recorded in Microsoft Excel and analyzed using SPSS V.25.0. The scientific soundness of the Delphi method is usually expressed by the effective response rate, authority coefficient (Cr), and coordination coefficient. The effective response rate is usually required to be above 70%, and the Cr determined by the familiarity (Cs) and judgment basis (Ca) of the research questions [Cr = (Ca + Cs)/2] must be above 0.700.[21] Cs represents the experts' familiarity with the research question and is divided into five levels: very familiar (0.9), relatively familiar (0.7), general (0.5), less familiar (0.3), and unfamiliar (0.1). Ca includes theoretical analysis, practical experience, referring to the literature, and self-intuition, which are divided into three grades: strong, medium, and weak, and corresponding weights are assigned according to the criteria's influence degrees[22] (Table 5). The Ca value was the sum of these criteria. The coordination of expert opinions was evaluated using the coefficient of variation (CV) and Kendall's coefficient (W). The lower the CV value, the higher the degree of coordination of the experts' opinions, and the general requirement of CV <0.25.[23] The higher The Kendall coefficient W, the higher is the degree of coordination.[24] Differences were considered statistically significant at two-tailed p-values < 0.05.

Results

Basic Information on the Participants

In two rounds of the survey, 16 consultation questionnaires were sent and 16 were recovered, with an effective response rate of 100%. Among the 16 experts, 75.00% were women, 68.75% had more than 10 years of working experience, and 87.50% had a master's degree or above.

Table 6 presented the basic characteristics of the experts.

The Authority Coefficient of Experts

The Cs and Ca scores were 0.738 and 0.925, respectively. The value of the expert authority coefficient Cr was 0.832 (>0.7)((0.738+0.925)/2). The results of the expert consultations were accurate and reliable.

Table 5 Judgment Basis for Consultation from Experts

Judgment Basis	Evaluation Criteria		
	Strong	Medium	Weak
Theoretical analysis	0.5	0.4	0.3
Practical experience	0.3	0.2	0.1
Referring to literature	0.1	0.1	0.1
Self-intuition	0.1	0.1	0.1

https://doi.org/10.2147/JPR.S494243

Table 6 The Basis Characteristics of the Experts (n=16)

Characteristics	N	%
Age (years)		
<40	7	43.75
40–50	8	50.00
>50	1	6.25
Sex		
Male	4	25.00
Female	12	75.00
Years worked		
5–9	5	31.25
10–19	6	37.50
>20	5	31.25
Highest academic title		
Bachelor's degree	2	12.50
Master's Degree	9	56.25
PhD	5	31.25
Professional field		
Medical	2	12.50
Nursing	7	43.75
Anesthesia	2	12.50
Others	5	31.25

The Coordination Degree of Expert Opinions

The CVs values of the two rounds were 0.00–0.41 (Table 4) and 0.05–0.17 (Table 7), respectively. The Kendall's W values for the two rounds were 0.114–0.222 ($p<0.05$) (Table 8). Thus, the degree of coordination of expert opinions was optimal.

Table 7 Pain Management Strategy After Hepatectomy

Items	$\bar{x} \pm s$	CV
1. Establish Acute Pain Service Team(APST)	4.94±0.25	0.05
1.1Establish an Acute Pain Service Team(APST), encompassing experts from specialties such as hepatology, pain management, surgery, nursing, oncology, pharmacy, pathology, and nutrition, etc.	4.94±0.25	0.05
1.2 Responsibilities of the APST: perioperative pain treatment and nursing, assessment of analgesic effects, management of adverse reactions, pain education, improving the comfort and satisfaction and reducing postoperative complications.	4.88±0.34	0.07
1.3 Continuing education: regularly participate in continuing education courses, update pain management concepts, and improve pain management ability.	–	–
2. Pain Management Principles	4.69±0.60	0.13
2.1 Preventive Analgesia: preventive analgesia to reduce surgical stress responses and optimize pain control procedure.	4.69±0.48	0.10
2.2 Multimodal Analgesia: multimodal analgesia by analgesic methods to achieve excellent pain relief with the fewest adverse effects.	4.69±0.48	0.10
2.3 Personalized Analgesia: formulate and implement pain management plan according to patient characteristics, pain level and requirement.	4.81±0.40	0.08
3. Pain Screening	4.81±0.40	0.08
3.1 Screening of past medical history, surgical and treatment experiences, pain history, medication history, allergy history, and cognitive and psychological status.	4.63±0.62	0.13
3.2 Screening of past or current substance use history, including abuse and addiction.	4.44±0.51	0.12
3.3 Screening the use, reaction and preference of analgesic measures (non drugs and drugs) in the past or current.	4.63±0.50	0.11

(*Continued*)

Table 7 (Continued).

Items	$\bar{x} \pm s$	CV
4. Make Pain Management Plan	4.81±0.40	0.08
4.1 Encourage patients and caregivers to actively participate in the formulation of pain management plans based on the results of pain screening and treatment objectives.	4.81±0.54	0.11
4.2 Dynamically adjust the pain management plan according to real-time feedback and regular evaluation results.	4.81±0.40	0.07
5. Time for Pain Assessment	4.94±0.25	0.05
5.1 Immediately start pain assessment as soon as the patient returns to the ward.	4.94±0.25	0.05
5.2 Dynamic monitoring of pain: evaluate every 2 hours within 6 hours, every 4 hours within 6 to 24 hours, and every 12 hours after 24 hours.	4.88±0.50	0.10
5.3 Patients with stable pain (such as numerical rating scale (NRS) ≤ 2 points for more than 3 consecutive times) were evaluated every 12 hours.	4.88±0.34	0.07
5.4 The analgesic effect was evaluated when it reached the peak, which is typically 15 to 30 minutes after parenteral administration and 1 to 2 hours after oral administration.	4.94±0.25	0.05
5.5 For the use of patient-controlled analgesia (PCA), continuously need to monitor and assess the number of ineffective button presses.	4.69±0.60	0.13
5.6 Immediately assess the effectiveness after implementing non-drug interventions.	4.69±0.60	0.13
5.7 Assess pain score at rest state.	4.63±0.72	0.16
5.8 Assess pain score during periods of activity, such as walk, sit up, cough and roll over.	4.75±0.58	0.12
5.9 Anesthesiology medical staff should visit the patients with pain at least once a day.	4.50±0.63	0.14
6. Pain Evaluation Tools	4.69±0.60	0.13
6.1 Emphasize the patient self-report is the primary basis of all pain assessments.	4.88±0.34	0.07
6.2 Select appropriate validated pain assessment tool based on the patient's age and cognitive-communication performance	4.88±0.34	0.07
7. Pain Assessment Content	4.81±0.54	0.11
7.1 Assess the patient's pain characteristics, including the cause, location, range, intensity, nature, occurrence and duration of pain, inducing factors and relief factors, whether there were accompanying symptoms, whether the pain affected the function and vital signs.	4.94±0.25	0.05
7.2 Evaluate the effect of pain relief after the implementation of drug treatment or pain intervention measure.	4.88±0.34	0.07
7.3 Evaluate the pain relief effect after drug or non drug intervention, and focus on the measures with significant effect.	4.69±0.48	0.10
7.4 Assess whether there are potential obstacles in the process of pain control, such as drug dependence, mental state, etc.	4.56±0.51	0.11
8. Drug Intervention	4.44±0.51	0.12
8.1It is recommended that postoperative analgesia be based on continuous nerve block (psoas block, thoracic paravertebral block, and transversus abdominis plane block) or local anesthetic wound infiltration, combined with multimodal analgesia (intravenous NSAIDs and (or) low-dose opioid + antiemetic), covering more than 48–72 hours.	4.88±0.34	0.07
8.2 Multimodal analgesia is recommended to be based on nonsteroidal anti-inflammatory drugs and acetaminophen.	4.94±0.25	0.05
8.3 It is suggested to use opioid therapy for moderate to severe postoperative pain, with oral administration as the first choice.	4.94±0.25	0.05
8.4 Avoid the use of analgesics via intramuscular injection.	4.69±0.87	0.19
9. Non-Drug Intervention	4.81±0.54	0.11
9.1 Consider transcutaneous electrical nerve stimulation (TENS) as an adjunct to relieve pain.	4.50±0.73	0.16
9.2 Cognitive behavioral therapy as part of multimodal analgesia.	4.63±0.81	0.17
9.3 Consider music therapy to relieve pain.	4.63±0.72	0.16
9.4 Consider pre-operative guided imagery and relaxation techniques.	4.56±0.73	0.16
10. Pain Record	4.69±0.60	0.13
10.1 Record the pain characteristics, adverse reactions, complications, treatment methods and results of the patients.	4.94±0.25	0.05
10.2 Record pain scores at rest and activity.	4.94±0.25	0.05
10.3 Record detailed pain management plans and specific goals, and promptly record the adjusted content.	4.75±0.58	0.12
10.4 It is suggested to use charts to record changes in postoperative pain intensity, forming a pain relief curve, and mark key information such as the timing of analgesic interventions, drug dosages, and changes in vital signs.	4.81±0.40	0.08

(*Continued*)

Table 7 (Continued).

Items	$\bar{x} \pm s$	CV
11. Pain Management Evaluation	4.69±0.60	0.13
11.1Evaluate the completeness of pain assessment and records.	4.75±0.58	0.12
11.2Obtain patients' satisfaction with the overall pain management process through questionnaires or interviews.	4.69±0.60	0.13
12. Pain Education	4.88±0.34	0.07
12.1 Pain health education are integrated from before admission to after discharge.	4.88±0.34	0.07
12.2Provide pain management knowledge to patients and their families through various forms, such as face-to-face consultation, distribution of educational manuals, playing educational videos, providing audio materials, or online educational resources.	4.88±0.50	0.10
12.3 Guide patients and caregivers to actively participate in pain management plans and processes.	4.75±0.58	0.12
12.4 Guide the correct use of pain assessment tools.	4.94±0.25	0.05
12.5 Introduce the treatment plan of postoperative pain management in detail, and correctly guide and apply drug and non-drug intervention.	4.69±0.48	0.10
13. Risk Control	4.50±0.52	0.11
13.1 According to the results of pain screening and assessment, identify the possible complications of patients and the risk of drug interactions, and timely and dynamically adjust the pain management plan.	4.94±0.25	0.05
13.2 Monitor the sedation level and respiratory function of using opioid drugs, and identify risks such as excessive sedation and respiratory depression or other adverse complication.	4.81±0.40	0.08
13.3 Develop an emergency plan for pain management risks to ensure that risks can be handled quickly and effectively.	4.63±0.72	0.16

Table 8 Expert Coordination Coefficients

Items	Indicators	Kendall's Coefficient of Concordance (W)	Degree of Freedom (df)	Chi-Square	*p*-Values
First round					
First level items	14	0.222	33	46.262	0.000
Second level items	62	0.143	61	139.315	0.000
Second round					
First level items	13	0.141	12	26.989	0.008
Second level items	47	0.114	46	84.182	0.001

Results of the Expert Questionnaire

First Round

In the first round, 49 comments were received. Based on expert advices and statistical analysis results, we have made the following revisions to the strategy. Eleven items were deleted, of which five (Items 8, 8.1, 8.2, 9.4, 9.5) had CV≥0.25, and six (Items 6.4, 9.3, 9.8, 12.1, 12.2, and 12.3) were the expert advice.

Two items (Items 2.3, 11.1) were added. Eleven items (Items 4.1, 4.2; 6.1, 6.2; 7.2, 7.3; 13.3, 13.5, 13.7; 14.1,14.4) were integrated. Three items needed clarification: (1) the time of pain assessment after surgery was modified to return to the ward (item 5.1); (2) we redefined the assessment time for pain stabilization (item 5.3); and (3) we added additional characteristics to the assessment of the pain (items 7.1). The other items included wording revisions.

Second Round

We received 15 comments in the second round, mainly regarding the wording revisions. One expert suggested adding an item for continuing education (item 1.3). Some comments were revised through panel discussion, and all items were agreed upon. Finally, 13 first-and 48 second-level items were included (Table 7).

Discussion

Based on the evidence summary and Delphi research, this study developed a pain management strategy for post-hepatectomy patients. Through two rounds of the expert questionnaire, the final strategy, including 13 first-level and 48 second-level items, was established, providing a reliable basis for clinical post-hepatectomy pain management.

Establish the Acute Pain Service Teams

The primary step in pain management after hepatectomy is to establish the acute pain service teams (APST). Through the unity and collaboration of multiple disciplinary management teams, including hepatology, pain departments, anesthesiologists, surgeons, and nurses, a comprehensive pain management plan is provided for patients to effectively reduce the incidence and severity of acute pain, complications, and adverse reactions and to increased patient satisfaction.[25–27] The APST has proven to increase the effectiveness of postoperative pain management.[27] However, challenges may be encountered in the establishment and maintenance of APST, such as resource allocation and cross-disciplinary communication barriers.[28] To overcome these challenges, establishing effective communication mechanisms, clarifying roles and responsibilities, and optimizing resource allocation. At the same time, future research should further explore how to optimize the operational processes of interdisciplinary teams.

The Principles of Pain Management

The essence of preventive analgesia is to implement effective intervention measures before the occurrence of pain, and to reduce or prevent pain caused by surgery or other injurious stimuli.[29] A network meta-analysis showed that preventive analgesia reduces postoperative pain, opioid consumption, postoperative nausea or vomiting, and delayed rescue analgesia.[30] However, there is still debate regarding its potential effectiveness.[31] Multimodal analgesia, a pivotal strategy in postoperative pain management, involves the combination of different analgesic techniques and medications with distinct mechanisms of action to achieve superior pain relief, while minimizing the side effects of individual agents.[32] Evidence supporting the efficacy of multimodal analgesia is substantial.[33,34] The results of Zhou[35] et al showed that multimodal preventive analgesia could effectively alleviate the postoperative pain, benefits early ambulation, improves recovery of gastrointestinal function, and shortens duration of hospital stay in patients with partial hepatectomy for liver cancer. However, challenges remain, such as the optimal timing and dosing of medications, the balance between analgesic efficacy and side effects, and individual variability in patient responses to different agents. Therefore, the clinical application of multimodal analgesia should be based on latest clinical evidence and guidelines. Personalized analgesia should be based on the characteristics of the patient, pain degree and needs.Patient-self-reported pain management is an important clinical practice that has been applied in cancer,[36] chronic pain,[37] and other areas. It emphasizes the active participation of patients in pain assessment and management processes to improve the individualization and effectiveness of pain treatment. In conclusion, the three pain management principles have important clinical significance and research value for improving postoperative recovery, reducing complications, improving quality of life and optimizing allocation of medical resources.

Pain Screening

The purpose of pain screening is to systematically assess the factors influencing pain, including assessment of past pain history, presence of comorbidities, past or current substance use history, and psychological status, for early identification and intervention of pain, improving the accuracy of pain management. Pain screening has been used in the fields of low back pain[38,39] and neuropathic pain,[40] and has formed a screening tool, and the research results show that it is a promising tool. A systematic review and meta-analysis showed that significant preoperative predictors of poor postoperative pain control included a history of depressive symptoms, anxiety symptoms, preoperative pain, and the use of preoperative analgesia.[41] Studies have shown a positive association between substance use and pain[42,43] such as alcohol, cannabis, and painkillers/sedatives/tranquilizers (PSTs). Therefore, screening for preoperative pain is necessary. The processes and standards of current pain screening methods are not comprehensive, and it is necessary to establish

a simple pain screening questionnaires and verify its feasibility in patients with liver cancer. But pain screening questionnaires should not replace a comprehensive clinical assessment.

Pain Assessment

The purpose of pain assessment is to dynamically and accurately identify and quantify pain, evaluate the causes of pain, and evaluate the effectiveness and side effects of treatment. Due to the subjectivity of pain, patient self-reporting is the gold standard for pain assessments.[7] Currently, the degree of pain is mainly quantified using tools, and the selection of pain assessment tools should be based on factors such as age, education level, cognitive status, and awareness level. The incidence of pain after hepatectomy is high and it is important to identify and treat postoperative pain as soon as possible. Therefore, the timing of postoperative evaluation of liver cancer is crucial. The first evaluation after surgery should be conducted immediately when the patient is awake, and dynamic monitoring of pain changes should be performed on the day of surgery (every 2 hours within 6 hours after surgery, every 4 hours between 6 and 24 hours, and every 12 hours after 24 hours). When the degree of pain is relieved and stable, the frequency of evaluation should be reduced; however, once the patient reports worsening pain or new symptoms, re-evaluation should be conducted immediately. This results is based on a study by Feng[10] et al and Chou, R[7] et al. One point worth noting is the assessment of the dynamic pain. Guidelines from organizations such as the American Pain Society (APS) and Swedish Society of Medicine (SSM) stated that a comprehensive postoperative pain assessment should include dynamic pain assessment,[44,45] but few studies have been specific about the timing of the assessment. Dynamic pain control plays an important role in promoting recovery and in reducing postoperative complications.[46] However, research on dynamic pain assessment in China has begun late, and there is still a lack of practical guidelines or operating procedures for postoperative dynamic pain assessment and treatment.

Drug and Non-Drug Interventions

The best practices for drug and non-drug management remain unclear. Non-drug intervention methods are diverse, including but not limited to music therapy, physical therapy, psychological support, cognitive behavioral therapy(CBT), and pain diaries. CBT is widely used to treat mental illnesses, and in recent years, it has been applied to the field of pain. Previous studies have shown that CBT alters brain perception and pain control.[47] This was proved by the results of Song[48] et al, which showed that CBT can reduce postoperative pain in patients with hepatectomy. Non-drug interventions are led by nurses, and Peterson et al[49] believed that the training of nurses in pain management should be emphasized, and that nurses require professional education in pain management as well as teaching skills in pain management, which can guide nurses in choosing appropriate non-drug interventions. Drug analgesia is an important part of pain management after hepatectomy. Clinicians should choose the corresponding analgesics for different types of pain and select different methods of analgesia, such as oral or intravenous administration, epidural analgesia, and patient-controlled analgesia (PCA). In addition, safety and patient factors should be considered to achieve the best analgesic effect with the smallest possible medication dose. The combination of drug and non-drug management interventions is of great significance in pain management to improve analgesia and reduce drug side effects.

Pain Education and Risk Control

Pain education should be integrated throughout the entire process from admission to discharge, which aims to help patients understand pain information, including pain mechanisms, pain assessment, and pain management, to promote effective pain control and improve their quality of life. Research has shown that pain education combined with psychological interventions can reduce pain intensity in patients with primary liver cancer.[50] In addition, caregivers should be encouraged to participate in the pain management process, and medical staff should provide personalized postoperative pain management education centered on patients and families in various ways, such as face-to-face guidance, written materials, and videos. However, there is insufficient evidence to determine the comparative effectiveness of different educational interventions or recommend specific interventions.

Pain risk control is an important component of pain management and involves the identification, assessment, monitoring, and mitigation of potential risks to ensure patient safety, improve the effectiveness of pain treatment,

and optimize the overall treatment experience for patients. Most of the analgesics are associated with serious side effects, such as NSAIDS can cause severe GI disturbance and opioids can cause addiction.[51] For patients using drugs for postoperative analgesia, particularly in the first few hours after surgery, close monitoring should be conducted to determine the risk of severe GI disturbance, excessive sedation and respiratory depression.[7] In addition, relevant contingency plans should be developed to ensure that risks are addressed quickly and effectively after they occur.

Limitation

The following problems were identified in this study. (1) Most of the entries were general content, with some specific entries for postoperative pain after hepatectomy. (2) This study provided a strategy for postoperative pain management, not a program. It was necessary to transform the plan according to the strategy; (3) this study focused on postoperative pain management and lacked a complete clinical pathway for pain management; and (4) this study did not adequately consider pain management for postoperative complications such as infection and bile leakage.

Conclusions

Based on systematic evidence summary and two rounds of Delphi study, pain management strategies were developed after hepatectomy, and finally summarized 13 first-level items and 48 second-level items, which provided a reference for scientific guidance in clinical nursing practice and had certain guiding significance for medical staff to conduct postoperative pain management of liver cancer. Furthermore, we plan to translate this into a plan and confirm its clinical feasibility. In clinical application, it is also necessary to consider the patient's preference, physical function and other aspects of the clinical situation.

Acknowledgments

Co-first authors: Yuqin Wang and Xiuxiu Song. Co-corresponding authors: Zhengxiang Han and Yuping Liu. This study was granted by The Affiliated Hospital of Xuzhou Medical University. The authors acknowledged the contributions of Yingfeng Zhou, Yingge Teng and Jianmei Wei.

Funding

This work was supported by the Xuzhou Science and Technology Bureau (project number: KC23281).

Disclosure

The authors declared that they had no conflicts of interest.

References

1. Missair A, Cata JP, Votta-Velis G, et al. Impact of perioperative pain management on cancer recurrence: an ASRA/ESRA special article. *Reg Anesth Pain Med*. 2019;44(1):13–28. doi:10.1136/rapm-2018-000001
2. Teng WN, Wu HL, Tai YH, Lei HJ, Tsou MY, Chang KY. Group-based trajectory analysis of postoperative pain and outcomes after liver cancer surgery. *JCMA*. 2021;84(1):95–100. doi:10.1097/JCMA.0000000000000446
3. Christian-Miller N, Frenette C. Hepatocellular cancer pain: impact and management challenges. *<![CDATA[Journal of Hepatocellular Carcinoma]]>*. 2018;5:75–80. doi:10.2147/JHC.S145450
4. Graf J, Stengel A. Psychological Burden and Psycho-Oncological Interventions for Patients With Hepatobiliary Cancers-A Systematic Review. *Frontiers in Psychology*. 2021;12:662777. doi:10.3389/fpsyg.2021.662777
5. Leng XS, Wei JM, Liu LX, et al. The Expert consensus of perioperative pain management in general surgery. *Chinese J of General Sur*. 2015;30 (2):166–173.
6. Simpson JC, Bao X, Agarwala A. Pain Management in Enhanced Recovery after Surgery (ERAS) Protocols. *Clin Colon Rectal Surg*. 2019;32 (2):121–128. doi:10.1055/s-0038-1676477
7. Chou R, Gordon DB, de Leon-Casasola OA, et al. Management of Postoperative Pain: a Clinical Practice Guideline From the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council. *J Pain*. 2016;17(2):131–157. doi:10.1016/j.jpain.2015.12.008
8. Chen GH, Jia WD, Yang Y, et al. Chinese expert consensus on enhanced recovery after hepatectomy (2017 Edition). *Chin J Hepatic Surg*. 2017;33 (10):1876–1882.

9. Gu WD, Zhao X, He ZZ. Shanghai expert consensus on perioperative analgesia managment in general surgery patients(2020 edition). *Chinese J Pract Sur*. 2021;41(01):31–37.
10. Feng Y, Zhang R. The Expert consensus of Multidisciplinary management team for pain management. *J Clin Anesthesiol*. 2017;33(01):84–87.
11. National Health Commission of the People's Republic of China. Standardization for Diagnosis and Treatment of Primary Hepatic Carcinoma(2022 Edition). *Cancer Res Prevent Treat*. 2022;27(03):251–276.
12. Villegas Estévez FJ, López Alarcón MD, Beato C, Sanz-Yagüe A, Porta-Sales J, Morera López RM. Procedural pain in patients with cancer: a Delphi expert management consensus. *BMJ Supportive & Palliative Care*. 2023;13(e2):e428–e436. doi:10.1136/bmjspcare-2020-002668
13. Aubrun F, Nouette-Gaulain K, Fletcher D, et al. Revision of expert panel's guidelines on postoperative pain management. *Anaesth Crit Care Pain Med*. 2019;38(4):405–411. doi:10.1016/j.accpm.2019.02.011
14. Omar A, Kaseb A, Elbaz T, et al. Egyptian Society of Liver Cancer Recommendation Guidelines for the Management of Hepatocellular Carcinoma. *J Hepatocell Carcinoma*. 2023;10:1547–1571. doi:10.2147/JHC.S404424
15. Cooney MF. Postoperative Pain Management: clinical Practice Guidelines. *J Perianesthesia Nurs*. 2016;31(5):445–451. doi:10.1016/j.jopan.2016.08.001
16. Registered Nurses' Association of Ontario. Registered Nurses' Association of Ontario. Assessment and Management of Pain (third edition). 2013, Accessed Nov 11, 2024. Available from: https://rnao.ca/bpg/guidelines/assessment-and-management-pain.
17. Cancer Prevention and Treatment Expert Committee C-SMEA. Chinese expert consensus on the peri-operative management of hepatectomy for liver cancer(2021 Edition). *Chin J Oncol*. 2021;43(4):414–430.
18. Xu JG. The Expert consensus of post-operative pain management in adults. *J Clin Anesthesiol*. 2017;33(09):911–917.
19. Coccolini F, Corradi F, Sartelli M, et al. Postoperative pain management in non-traumatic emergency general surgery: WSES-GAIS-SIAARTI-AAST guidelines. *World J Emergency Surg*. 2022;17(1):50. doi:10.1186/s13017-022-00455-7
20. Borel MCG, Lopes ROP, Thofehrn MB, Nóbrega M, Arreguy-Sena C, Brandão MAG. Guideline for incorporating the Delphi method in the evaluation of nursing theories. *Revista latino-americana de enfermagem*. 2021;29:e3387. doi:10.1590/1518-8345.4157.3387
21. Mao X, Loke AY, Hu X. Developing a tool for measuring the disaster resilience of healthcare rescuers: a modified Delphi study. *Scand J Trauma, Resuscitation Emergency Med*. 2020;28(1):4. doi:10.1186/s13049-020-0700-9
22. Romero-Collado A. Essential elements to elaborate a study with the (e)Delphi method. *Enfermeria intensiva*. 2021;32(2):100–104. doi:10.1016/j.enfi.2020.09.001
23. Nasa P, Jain R, Juneja D. Delphi methodology in healthcare research: how to decide its appropriateness. *World J Methodol*. 2021;11(4):116–129. doi:10.5662/wjm.v11.i4.116
24. Egfjord KF, Sund KJ. A modified Delphi method to elicit and compare perceptions of industry trends. *MethodsX*. 2020;7:101081. doi:10.1016/j.mex.2020.101081
25. Glowacki D. Effective pain management and improvements in patients' outcomes and satisfaction. *Critical Care Nurse*. 2015;35(3):33–41. doi:10.4037/ccn2015440
26. Kim BR, Yoon SH, Lee HJ. Practical strategies for the prevention and management of chronic postsurgical pain. *Korean J Pain*. 2023;36(2):149–162. doi:10.3344/kjp.23080
27. Lovasi O, Lám J, Kósik N. The role of acute pain service in postoperative pain relief. *Orvosi hetilap*. 2020;161(15):575–581. doi:10.1556/650.2020.31680
28. Jenkins AM, Weber DE, Arfaa JJE, et al. Using participatory research to identify actionable facilitators and barriers to effective inpatient interdisciplinary communication. *J Hospital Med*. 2023;18(2):130–138. doi:10.1002/jhm.13013
29. Kissin I, Weiskopf R. Preemptive analgesia. *Anesthesiology*. 2000;93(4):1138–1143. doi:10.1097/00000542-200010000-00040
30. Xuan C, Yan W, Wang D, et al. Efficacy of preemptive analgesia treatments for the management of postoperative pain: a network meta-analysis. *Br J Anaesth*. 2022;129(6):946–958. doi:10.1016/j.bja.2022.08.038
31. Sáez VP. Review: effect of preventive analgesia on postoperative pain. *Revista espanola de anestesiologia y reanimacion*. 2012;59(1):43–50. doi:10.1016/j.redar.2011.11.003
32. O'Neill A, Lirk P. Multimodal Analgesia. *Anesthesiology Clinics*. 2022;40(3):455–468. doi:10.1016/j.anclin.2022.04.002
33. Beverly A, Kaye AD, Ljungqvist O, Urman RD. Essential Elements of Multimodal Analgesia in Enhanced Recovery After Surgery (ERAS) Guidelines. *Anesthesiology Clinics*. 2017;35(2):e115–e143. doi:10.1016/j.anclin.2017.01.018
34. Gelman D, Gelmanas A, Urbanaitė D, et al. Role of Multimodal Analgesia in the Evolving Enhanced Recovery after Surgery Pathways. *Medicina*. 2018;54(2):20. doi:10.3390/medicina54020020.
35. Zhou H, Jia WD, Qiao XF, Liu FP, Chen L, Hu CL. Clinical values of multimodal preventive analgesia in patients with partial hepatectomy for liver cancer. *Chin J Surg*. 2017;55(2):141–145.
36. Zhi WI, Gentile D, Diller M, et al. Patient-Reported Outcomes of Pain and Related Symptoms in Integrative Oncology Practice and Clinical Research: evidence and Recommendations. *Oncology*. 2021;35(1):35–41.
37. Pogatzki-Zahn E, Schnabel K, Kaiser U. Patient-reported outcome measures for acute and chronic pain: current knowledge and future directions. *Current Opinion in Anaesthesiology*. 2019;32(5):616–622. doi:10.1097/ACO.0000000000000780
38. Pauli J, Starkweather A, Robins JL. Screening Tools to Predict the Development of Chronic Low Back Pain: an Integrative Review of the Literature. *Pain Medicine*. 2019;20(9):1651–1677. doi:10.1093/pm/pny178
39. Melloh M, Elfering A, Egli Presland C, et al. Identification of prognostic factors for chronicity in patients with low back pain: a review of screening instruments. *International Orthopaedics*. 2009;33(2):301–313. doi:10.1007/s00264-008-0707-8
40. König SL, Prusak M, Pramhas S, Windpassinger M. Correlation between the Neuropathic PainDETECT Screening Questionnaire and Pain Intensity in Chronic Pain Patients. *Medicina*. 2021;57(4). doi:10.3390/medicina57040353
41. Yang MMH, Hartley RL, Leung AA, et al. Preoperative predictors of poor acute postoperative pain control: a systematic review and meta-analysis. *BMJ open*. 2019;9(4):e025091. doi:10.1136/bmjopen-2018-025091
42. Roberts W, Moore KE, Verplaetse TL, et al. Prospective Associations of Pain Intensity and Substance Use in the United States Population: a Cross-Lagged Panel Analysis. *J Studi Alcohol Drugs*. 2021;82(5):576–583. doi:10.15288/jsad.2021.82.576
43. Ditre JW, Zale EL, LaRowe LR. A Reciprocal Model of Pain and Substance Use: transdiagnostic Considerations, Clinical Implications, and Future Directions. *Ann Rev Clin Psychol*. 2019;15(1):503–528. doi:10.1146/annurev-clinpsy-050718-095440

44. Gordon DB, Dahl JL, Miaskowski C, et al. American pain society recommendations for improving the quality of acute and cancer pain management: American Pain Society Quality of Care Task Force. *Archives of Internal Medicine*. 2005;165(14):1574–1580. doi:10.1001/archinte.165.14.1574
45. Ene KW, Nordberg G, Bergh I, Johansson FG, Sjöström B. Postoperative pain management - The influence of surgical ward nurses. *J Clin Nurs*. 2008;17(15):2042–2050. doi:10.1111/j.1365-2702.2008.02278.x
46. Breivik H, Borchgrevink PC, Allen SM, et al. Assessment of pain. *Br J Anaesth*. 2008;101(1):17–24. doi:10.1093/bja/aen103
47. Bao S, Qiao M, Lu Y, Jiang Y. Neuroimaging Mechanism of Cognitive Behavioral Therapy in Pain Management. *Pain Res Manag*. 2022;2022:6266619. doi:10.1155/2022/6266619
48. Song HX, Song YH, Gu SS, et al. Effects of cognitive behavioral intervention under painless concept on pain score and psychological state in patients undergoing laparoscopic hepatectomy. *Chinese Journal of Clinical Research*. 2024;37(1):141–146.
49. Peterson A, Berggården M, Schaller AS, Larsson B. Nurses' Advocacy of Clinical Pain Management in Hospitals: a Qualitative Study. *Pain Management Nursing: Official Journal of the American Society of Pain Management Nurses*. 2019;20(2):133–139. doi:10.1016/j.pmn.2018.09.003
50. Liu JH, Huang B. Effects of pain education combined with psychological intervention on postoperative mental resilience and stress hormone levels in patients with primary liver cancer. *Chin J Health Psychol*. 2023;31(3):387–392.
51. Sucheta R, Nanda S, Pathak D, Pathak D. Analgesic Prodrugs for Combating their Side-Effects: rational Approach. *Current Drug Delivery*. 2017;14(1):16–26. doi:10.2174/1567201813666160504100705