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Retrospective Study

Clinical application of multidisciplinary team- and evidence-based practice project in gynecological patients with perioperative hypothermia

Qing-Yan Liu, Tong-Yang You, Dai-Ying Zhang, Juan Wang

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Abstract

BACKGROUND

Perioperative hypothermia (PH) negatively affects the physical and mental health of patients to varying degrees. Currently, there is no effective multidisciplinary team (MDT) intervention for gynecological patients with PH.

AIM

To apply the best evidence on the prevention and management of PH in gynecological patients, improve the quality of perioperative evidence-based care based on treatment by an MDT for gynecological patients and analyze the effect of MDT- and evidence-based practice (EBP) projects on the psychological status and cognitive function of gynecological patients with PH.

METHODS

Under the guidance of knowledge translation and combined with the opinions of involved stakeholders and clinical experts, the best evidence for PH prevention and management in gynecological patients was selected and adjusted to suit the practice setting. Based on the evidence, the practice plan was developed, and the MDT intervention was carried out in the preoperative ward, the preoperative preparation room, the intraoperative operating room, the postanesthesia care unit, and the 24-hour postoperative gynecological ward through the EBP program. The incidence of hypothermia, the nurses' awareness, the implementation rate of examination indicators, and the thermal comfort level, psychological status and cognitive function of patients were compared before and after the implementation of the program.

RESULTS

The incidence of PH in gynecological patients decreased from 43.33% to 13.33% after the implementation of the scheme. The implementation rate of examination

indicators 6-10, 12, 14, 16-18, 21, and 22 reached 100%, and that of other indicators was above 90%, except for examination indicators 5 and 13, which was 66.67%; the indices were significantly improved compared with the baseline (before evidence application) ($P < 0.05$). The score of nurses' awareness of PH prevention and management in gynecological patients increased from 60.96 ± 9.70 to 88.08 ± 8.96 , and the difference was statistically significant ($P < 0.001$). The total score of the perioperative thermal comfort level of patients undergoing gynecological surgery was 27.97 ± 2.04 , which was significantly increased compared with the score of 21.27 ± 1.57 observed by researchers at baseline ($P < 0.001$). The perioperative Hamilton Depression Scale and Hamilton Anxiety Scale scores of patients undergoing gynecological surgery decreased from 15.03 ± 3.16 and 13.93 ± 2.64 to 4.30 ± 1.15 and 3.53 ± 0.78 , respectively, with statistically significant differences ($P < 0.001$). The perioperative Montreal Cognitive Assessment Scale score of the gynecological surgery patients increased from 23.17 ± 1.68 to 26.93 ± 1.11 , also with statistical significance ($P < 0.001$).

CONCLUSION

MDT-based EBP for PH prevention and management in gynecological patients during the perioperative period can standardize nursing operations, improve nurses' awareness and behavioral compliance with gynecological hypothermia management, and reduce the occurrence of PH in gynecological patients while playing a positive role in reducing patients' negative emotions and enhancing their cognitive function.

Key Words: Hypothermia; Gynecology; Evidence-based care; Knowledge translation; Multidisciplinary team

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Core Tip: At present, there is a lack of effective measures for perioperative hypothermia (PH) management in gynecological patients in China. This study verified the effectiveness of evidence-based practice project based on multi-disciplinary team in PH management of gynecological patients from the aspects of incidence of hypothermia, nurses' awareness, implementation rate of examination indicators, and the thermal comfort level, psychological status and cognitive function of patients.

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INTRODUCTION

Perioperative hypothermia (PH) refers to the phenomenon in which the body's core temperature is lower than 36 °C for various reasons in surgical patients[1] and has a high incidence. PH can delay the action time of anesthetic drugs, trigger unexpected events such as respiratory depression, vomiting and chills, and increase postoperative cardiovascular system complications, postoperative infection risk, coagulation dysfunction and other adverse consequences[2], prolonging the hospitalization time of surgical patients, increasing their hospitalization medical expenses and economic burden, and reducing social satisfaction[3]. Due to preoperative transfer, intraoperative anesthesia, the use of large amounts of flushing fluid, and the placement of patients in special positions, the incidence of PH in gynecological patients in China ranges from 31.3% to 65%[4,5], which is high, and the incidence in postanesthesia care units (PACUs) reaches 22.0%[6], necessitating improvement. The prevention and management of PH in gynecological patients is the responsibility of the multidisciplinary team (MDT)[7]. At present, the foreign practice guidelines and evidence summary on PH prevention and management are relatively comprehensive and mature. In contrast, although there are relevant studies and evidence on PH in China, none of them have been carried out according to the characteristics of gynecological patients, nor have they been effectively applied to clinical practice in China, resulting in a substantial difference between practice and evidence. In addition, there is no MDT intervention to improve the status quo of PH in patients. All these factors can explain the high incidence of PH in gynecological patients in China.

Knowledge translation (KT) refers to studying how to apply research evidence or clinical practice guidelines based on research evidence to clinical practice. The Knowledge-to-Action (KTA) framework, the most commonly used in KT theoretical frameworks, divides the KT process into knowledge creation and knowledge application, promoting the synthesis, dissemination and application of knowledge. The KT framework is a dynamic process through which knowledge producers (*i.e.*, researchers) and knowledge applicators (*i.e.*, practitioners) are integrated in a cooperative and interactive manner, reflecting a complete cycle from knowledge creation to application and providing a clear conceptual framework for the translation of knowledge into practice[8]. The application of an MDT under the guidance of KT may be of great help to the management of PH in gynecological patients. The MDT model of diagnosis, treatment and care has been shown to be one of the important models in medicine worldwide, which emphasizes patient-centered, curative effect-oriented, and evidence-based medicine to provide patients with all-round, personalized, refined, effective and

reasonable medical services[9]. MDT management has been shown to effectively improve the quality of life of patients with gynecological malignancies[10], promote their rapid recovery[11], and enhance the comprehensive ability of gynecological nurses[12]. To effectively prevent and manage the occurrence of PH in gynecological patients, the MDT-based evidence-based practice (EBP) project applies the best evidence scheme for the prevention and management of PH in gynecology, providing new ideas for solving the problem of PH in gynecological patients.

MATERIALS AND METHODS

Presentation of clinical problems

Based on a literature review and clinical practice, the clinical question "How can the incidence of PH be reduced in gynecological patients?", was identified and transformed into evidence-based problems according to the Population, Intervention, Control, and Outcome approach: (1) Population: Adult patients (≥ 18 years old) who underwent gynecological surgery (laparoscopy/hysteroscopy/Laparotomy) for 2 h or more; (2) Intervention: Prevention and management strategies of unplanned PH; (3) Control: Clinical routine nursing measures; and (4) Outcome: The implementation rate of examination indicators, nurses' awareness scores, incidence of hypothermia in gynecological patients, standardized procedures for PH prevention and management in gynecological patients, and psychological status and cognitive function of gynecological patients.

Construction of an evidence-based group

The team consisted of 9 members, including 2 operating room head nurses, 1 head nurse in the anesthesiology department, 1 head nurse in the gynecology department, 3 floor nurses, and 2 postgraduate students. Among them, the operating room head nurses were responsible for the overall research design and guidance; the postgraduates were responsible for evidence extraction, baseline review, data collection and analysis; and the remaining team members were responsible for nurse training, organization and coordination, and quality supervision.

Evidence acquisition

In this study, relevant clinical practice guidelines, expert consensus, evidence summaries and systematic reviews were retrieved from databases such as PubMed/Medline, JBI's Evidence-based Practice Database, the Cochrane Library, National Institute of Health and Care Excellence, Registered Nurses Association of Ontario, OVID, Science Direct, Association of the Scientific Medical Societies in Germany (AWMF), Association of Operating Room Nurses, China National Knowledge Infrastructure, Wanfang Data Knowledge Service Platform, and Chinese BioMedical Literature Database from 2000 to April 2021. Of the 592 documents retrieved, 7 articles were included after reading the abstracts and full texts and evaluating the literature quality, including 2 guidelines[13,14], 2 expert consensus[2,15], and 3 systematic reviews[16-18]. For the guidelines included, the quality was quantitatively evaluated using the Appraisal of Guidelines for Research and Evaluation instrument II[19], and the results are shown in Table 1. The Assessment of Multiple Systematic Reviews score[20] was used for quality assessment of the systematic reviews included, with the results presented in Table 2. For expert consensus, the quality was assessed by referring to JBI's critical appraisal tools[21]; the evaluation results of all the other items of the two articles were "Yes" except Item 6, "Are there any inconsistencies between all the proposed opinions and previous documents?" The research design of the included articles was complete, and the overall quality was high, which met the inclusion criteria. A total of 26 pieces of relevant evidence were obtained through the included studies, as shown in Table 3.

Selection of evidence suitable for clinical settings

The KTA model emphasizes the appropriate selection of evidence to suit specific clinical scenarios[8] and the adjustment of evidence with the input of stakeholders. In this study, 16 nurses and doctors from different departments (operating room, department of gynecology, and department of anesthesiology) with different academic qualifications and working years were selected as stakeholders by purposive sampling to select evidence suitable for clinical settings. Then, the stakeholders selected and adjusted evidence from the aspects of applicability, suitability, effectiveness and clinical significance. According to the opinions of the involved stakeholders, the applicability of heating humidification for oxygen inhalation was not considered feasible, so the evidence "to provide heated and humidified oxygen therapy for patients" was deleted (see Table 4 for the final included evidence).

Identification of gaps between evidence and clinical practice

To introduce evidence into clinical practice, this study evaluated the readiness of EBP. According to the evidence introduced into clinical practice, a total of 23 examination indicators were used as the evaluation criteria to investigate the current status of evidence application for PH prevention and management in gynecological patients in the pilot wards. The research subjects and examination methods are shown in Table 4. The review was jointly completed by the researcher and another member of the research team. Before the review, the examination contents and evaluation methods were further confirmed with the research team to ensure consistency. Except for indicators 1, 10, 12, 18, and 19, the implementation rate of other indicators was less than 50%, with the implementation rate of indicators 4 and 22 even being 0, suggesting the need to improve the completion of evidence implementation by medical staff. Therefore, this study investigated the awareness of relevant medical staff in the pilot wards on the prevention and management of PH in gynecological patients. A self-designed questionnaire was developed based on the evidence content to assess nurses' knowledge

Table 1 Quality evaluation results of the included guidelines

Ref.	Percentage of standardization in various fields						Number of domains $\geq 60\%$ (n)	Number of domains $\geq 30\%$ (n)	Recommended level
	Scope and purpose	Stakeholder involvement	Rigor of development	Clarity of presentation	Applicability	Editorial independence			
Torossian <i>et al</i> [13]	100	88.89	79.17	100	68.75	62.5	6	6	A
Hooper <i>et al</i> [14]	88.89	52.78	62.5	80.56	43.75	20.84	3	5	B

Table 2 Quality evaluation results of the included systematic reviews

Indicators	Galvão <i>et al</i> [17]	Moola and Lockwood [18]	Wang and Mao [16]
Was an "a priori" design provided?	Yes	Yes	Yes
Was there duplicate study selection and data extraction?	Yes	Yes	Yes
Was a comprehensive literature search performed?	Yes	Yes	Yes
Was the status of publication used as an inclusion criteria, such as grey literature?	No	Yes	No
Was a list of studies provided?	Yes	Yes	Yes
Were the characteristics of the included studies provided?	Yes	Yes	Yes
Was the scientific quality of the included studies assessed and documented?	Yes	Yes	Yes
Was the scientific quality of the included studies used appropriately in formulating conclusions?	Yes	Yes	Yes
Were the methods used to combine the findings of studies appropriate?	Yes	Yes	Yes
Was the likelihood of publication bias assessed?	No	No	Yes
Was the conflict of interest stated?	Yes	Yes	No

level (20 items for hypothermia identification, assessment, prevention, treatment and health education domains, with 2.5 points for each item) and practice level (10 items for the aspects of attitude and awareness of the prevention and management of PH in gynecological patients, with 5 points for each item), with a total score of 100 points. A total of 49 nurses in the pilot wards were enrolled, and the inclusion criteria were as follows: (1) Working in the department for more than 2 years; and (2) Voluntary participation in this study. The awareness of nurses regarding PH prevention and management in gynecological patients was 60.96 ± 9.70 points, which was at the medium level.

Development of MDT-based EBP project

Based on the evidence content, the investigation results of the implementation of the examination indicators in the pilot wards and the awareness of the associated medical staff, as well as the "Promoting Action on Research Implementation in Health Services Integrated Framework (i-PARIHS)" [22], semistructured interviews were conducted among nurses from different wards with different seniority levels to identify barriers and facilitators for the implementation of the protocol. After the formulation of action strategies, the evidence-based team developed an EBP project for PH prevention and management in gynecological patients, compiled a manual of relevant surgical education and knowledge, developed a thermal comfort rating scale, and unified the comprehensive thermal insulation methods and procedures for gynecological surgery patients. After the formation of the scheme, the evidence-based team discussed the comprehensiveness and clinical feasibility of the scheme item by item with the hospital management team members and nine experts with extensive perioperative nursing experience in gynecology, and the program was unanimously recognized.

EBP program application and effect evaluation

Practice site: The EBP program of this study was conducted in the operating room and gynecology and anesthesiology departments of a grade III-A hospital in Sichuan Province, with a total of 49 nurses participating (see 1.5 for the inclusion criteria).

Implementation of the EBP project: The EBP project was implemented from August to October 2021. The KTA model notes that to promote changes in practice, effective action strategies should be developed according to the barriers to evidence application. This study drew on the i-PARIHS framework to analyze the barriers and facilitators in the application of evidence for the prevention and management of PH in gynecological patients in pilot wards, with the

Table 3 Contents of the best evidence

Stage	Evidence
Preoperative ward	<p>To educate patients on thermal insulation and matters needing attention before surgery</p> <p>To measure and record the patient's axillary temperature before surgery</p> <p>To actively warm patients whose body temperature is below 36°C to 36°C and keep the patient warm during transfer</p>
Preoperative preparation room	<p>To assess the risk factors for hypothermia in patients</p> <p>To use a temperature monitoring equipment to measure and record the patient's body temperature before anesthesia induction</p> <p>To preheat 10-30 min before anesthesia induction</p> <p>To use carbon fiber heating wire to actively and continuously warm patients with body temperature below 36°C to above 36°C</p> <p>To maintain the operating room temperature no less than 24°C, and to lower the temperature only when active heating is established</p>
Intraoperative operating room	<p>To adopt an effective comprehensive thermal insulation strategy after anesthesia and maintain the axillary temperature at least 36.5°C</p> <p>To expose the surgical area and cover the rest for thermal insulation</p> <p>The infusion pipeline is continuously heated to 37°C if the intravenous infusion volume is more than 500ml.</p> <p>To heat the washing solution with a thermostatic chamber to 38-40°C</p> <p>To perform continuous intraoperative monitoring and recording every 15 min</p> <p>To evaluate intraoperative risk factors and hypothermia symptoms and signs</p>
Postanesthesia care unit	<p>To measure the body temperature and record it every 15 min. Passive insulation is adopted if there is no hypothermia. Monitoring site: armpit</p> <p>To adjust the PACU ambient temperature to 24°C</p> <p>To evaluate the patient's thermal comfort level</p> <p>To actively warm patients whose body temperature is below 36°C to above 36°C</p> <p>To heat the intravenous fluids</p> <p>To provide heated and humidified oxygen therapy for patients</p> <p>To transfer the patient out of PACU only when her body temperature is $\geq 36^{\circ}\text{C}$</p>
24-hour postoperative gynecological ward	<p>To measure, monitor and record the body temperature every 4 h</p> <p>To cover to keep warm</p> <p>To educate family members thermal insulation methods: blankets, socks, clothes, raising the ambient temperature, hot water, <i>etc.</i></p> <p>To continuously and actively warm patients below 36°C until they feel warm and comfortable, and to monitor and record every 30 min</p> <p>To evaluate the patient's thermal comfort level</p> <p>To pay close attention to patients' psychological changes, perceive their potential negative emotions such as anxiety and depression, and give timely relief and comfort</p> <p>To patiently answer any problems that may cause psychological distress to patients, and help them establish a positive attitude</p>

PACU: Postanesthesia care unit.

results presented in Table 5. According to the barriers and the actual situation in the wards, the following action strategies were developed for the smooth implementation of the EBP project.

Effect evaluation: The research participants consisted of 16, 13, and 20 nurses from the gynecological operating room, anesthesiology department, and gynecology department, respectively, as well as 60 patients undergoing gynecological surgery (inclusion criteria: Age ≥ 18 years; operation time ≥ 2 h; good cognitive and responsive skills; voluntary participation in this study). The effect of the EBP project was evaluated by a controlled before-and-after trial among nurses and a nonconcurrent control trial among patients.

Table 4 Relationship between evidence, practice protocol related documentation and examination indicators

Stage	Evidence suitable for clinical scenarios	Practice protocol related documentation	Examination indicators	Examination objectives and methods
Preoperative ward	To educate patients on thermal insulation and matters needing attention before surgery	Manuals and videos of perioperative health education (patient edition)	The operating room has propaganda materials on hypothermia prevention and management	Department: Document consultation
			Checking the preoperative follow-up sheet of gynecological surgery patients	Medical staff: Document consultation and observation
	To measure and record the patient's axillary temperature before surgery	Surgical patient handover/transfer proforma	Checking the surgical patient handover/transfer proforma	Medical staff: Document consultation and observation
	To actively warm patients whose body temperature is below 36°C to 36°C and keep the patient warm during transfer	Hypothermia emergency procedures	The operating room has a hypothermia emergency process to ensure continuous heat preservation during patient transfer	Medical staff: Document consultation and observation
Preoperative operating room	To assess the risk factors for hypothermia in patients	Hypothermia risk factor evaluation sheet	The operating room has an evaluation sheet to evaluate the risk factors of hypothermia in patients	Operating Room: document consultation
	To use a temperature monitoring equipment to measure and record the patient's body temperature before anesthesia induction	Procedure for the use of temperature monitoring equipment	Before anesthesia induction, a temperature monitoring equipment is used for patients with operation duration of 2h or longer	Medical staff: Observation and document consultation
	To actively warm patients whose body temperature is below 36°C to above 36°C	Active heat preservation methods for hypothermia patients	Effective warming strategies are taken for hypothermia patients	Medical staff: Observation and document consultation
	To preheat 10-30 min before anesthesia induction	Pre-heat preservation methods	10-30 min of pre-heat preservation is performed on gynecological patients before anesthesia induction	Medical staff: Observation
	To maintain the operating room temperature no less than 24°C, and to lower the temperature only when active heating is established	-	The operating room ambient temperature is adjusted to 24°C and above before surgery	Medical staff: Observation
Intraoperative operating room	To adopt an effective comprehensive thermal insulation strategy after anesthesia and maintain the axillary temperature at least 36.5°C	Intraoperative comprehensive thermal insulation strategies (active and passive thermal insulation, blood transfusion and infusion warming, continuous dynamic monitoring of body temperature, etc.)	According to the probability of hypothermia in gynecological patients during operation, a corresponding comprehensive heat preservation strategy is selected to maintain the axillary temperature of the patient at least 36.5°C	Medical staff: Observation, document consultation
	To expose the surgical area and cover the rest for thermal insulation	-	The surgical area is exposed and the rest is covered for thermal insulation	Medical staff: Observation
	To warm the intravenous fluid or blood transfusion with a warming device to 37°C if the amount was ≥ 500 mL	Procedure for the use of infusion pipeline heating instrument	The infusion pipeline was warmed for those with a intravenous fluid or blood transfusion volume ≥ 500 mL	Medical staff: Observation
	To heat the intraoperative washing solution with a thermostatic chamber to 38-40°C	-	The washing solution is used at 38-40°C	Medical staff: Observation
	To continuously monitor and record the patient's body temperature once every 30 min intraoperatively, and to record it once every 15 min during recovery from anesthesia	-	The body temperature is continuously monitored and recorded on time intraoperatively	Medical staff: Observation, document consultation
	To evaluate hypothermia symptoms and signs during the operation	Evaluation methods of symptoms and signs of hypothermia in patients during operation	The patient is observed for symptoms and signs of hypothermia during the operation	Medical staff: Observation
PACU	To measure the body temperature and record it every 15 min. Passive	Active insulation methods and temperature handover record for	The patient's temperature is measured and the hypothermia patients are	Medical staff: Observation,

	thermal insulation is adopted for those without hypothermia, and active thermal insulation is taken to above 36°C for those below 36°C	hypothermia patients	warmed effectively, and the temperature handover record is established	document consultation
	To adjust the PACU ambient temperature to 24°C	-	The PACU temperature is adjusted to 24°C and above	Medical staff: Observation
	To send the patient back to the ward when the body temperature is not lower than 36°C	-	The patient is transferred out from the PACU only when the body temperature is $\geq 36^{\circ}\text{C}$	Medical staff: Observation, document consultation
24-hour postoperative gynecological ward	To monitor and record the patient's axillary temperature every 4 h	-	The patient's axillary temperature is measured and recorded every 4 h	Medical staff: Observation, document consultation
	To cover to keep warm	-	The patient is covered to keep warm	Medical staff: observation
	To teach the patient's family how to keep warm effectively	Health education handbook	The patient's family members' are informed of effective thermal insulation methods	Medical staff: Observation and questioning
	To continuously and actively warm patients below 36°C until they feel warm and comfortable, and to monitor and record every 30 min	Active heat preservation methods for hypothermia patients	The hypothermia patients are continuously and actively warmed, with their body temperatures monitored and recorded every 30 min	Medical staff: Observation, document consultation
	To evaluate the patient's thermal comfort level	Thermal comfort rating scale	The patient's thermal comfort level is assessed	Medical staff: Document consultation

PACU: Postanesthesia care unit.

Table 5 Barriers and action strategies for prevention and management of hypothermia in patients

Serial number	Obstacle	Action strategy
1	Nurses lack relevant knowledge and awareness of perioperative hypothermia management of gynecological patients	To hold special training to explain relevant knowledge to nurses with PPT combined with nursing knowledge handbook, and to explain various procedures and nursing norms through on-site demonstration and watching operation videos. To ensure that nurses in the operating room, anesthesiology department and gynecology department receive knowledge training on hypothermia prevention at least once every six months, and to assess them for knowledge and practice at least once a year after training
2	The contents of health education on the day before surgery vary greatly and lacks gynecological expertise	To formulate a preoperative education manual of gynecology specialty, and to push the preoperative education video for gynecological patients by WeChat official account
3	The lithotomy position is mostly commonly used posture in gynecological surgery, resulting in inadequate ankle and foot warmth. In addition, there is a lack of special thermal insulation equipment for the lithotomy position	To purchase lithotomy position-dedicated strip-shaped inflatable heating blankets, wrap the patient's legs with cotton pads, and use sterile leg covers to meet the warm-keeping requirements of patients undergoing surgery in the lithotomy position
4	There are communication barriers among multi-department nurses on the prevention and management of perioperative hypothermia in gynecological patients	To establish a perioperative hypothermia prevention and management group led by the head nurses who also play a key role in the practice reform, with operating room gynecological specialists, anesthesiology nurses, gynecological nurses as the team members and the head nurses of the three departments as the group leaders. To establish a WeChat exchange group to remind, supervise and control the quality in the preoperative ward, preoperative preparation room, intraoperative operating room and postoperative PACU. To listen to the feedback and suggestions of nurses and patients during field observation, and adjust and optimize the nursing process. The head nurse should report the practice changes to the evidence-based practice group every month, so as to discuss, analyze and solve the problems that arise
5	There is a lack of corresponding evaluation tools	To introduce the intraoperative hypothermia risk prediction model calculation software constructed by Professor Huang Yuguang to evaluate the hypothermia risk of patients, and to explain the checked contents. To self-develop a thermal comfort scale, and conduct unified training for medical staff

PACU: Postanesthesia care unit; PPT: Power point.

Outcome measures: (1) The implementation rate of examination indicators was as follows: The evidence suitable for clinical situations was converted into measurable and easy-to-assess quality examination indicators. If the examination indicators were correctly executed, they were marked with "√". Unimplemented or incorrectly implemented indicators were marked with "×". The percentage of correct implementations was calculated as the percentage of the number of correct implementations out of the total number of implementations; (2) The incidence of PH was evaluated as follows: The incidence of PH in 30 gynecological patients from April to June 2021 and another 30 gynecological patients from October 2021 to December 2021 was statistically analyzed; (3) The awareness level of nurses (gynecological operating room, anesthesiology department, and gynecology department) regarding PH prevention and management in gynecological patients was evaluated as follows: A self-designed questionnaire based on evidence content was used for assessment (see 1.5 for details); (4) The thermal comfort level of gynecological patients was investigated as follows: The operating room, PACU and gynecological ward patients were scored by the Visual Analog Scale. The scale has 10 items, with 10 points each and a full score of 30; (5) Psychological status was evaluated as follows: Patients' depression and anxiety were evaluated by the Hamilton Depression Scale (HAMD) and Hamilton Anxiety Scale (HAMA), respectively, whereby the HAMD score range was 0-68 and the HAMA score range was 0-56, both of which were directly proportional to depression and anxiety; and (6) Cognitive function was analyzed as follows: Patients' cognitive function was evaluated with the Montreal Cognitive Assessment Scale (MoCA; score range: 0-30). A score of 26 was considered normal, and a score less than 26 was indicative of cognitive function decline; in addition, the score was increased by 1 point if the patient's years of schooling was less than 12 years.

Data collection methods: Baseline review data were collected from April 2021 to June 2021, and data collection and analysis after program application were carried out from October 2021 to December 2021. A researcher followed up and observed the implementation of examination indicators and the occurrence of hypothermia on a daily and patient-by-patient basis and recorded it truthfully. (1) Document consultation: For indicators 1-7, 10, 14, 16, 18-19, and 22-23, the rules and regulations of the department, the relevant processes and the training records were checked; (2) Observation and questioning: For indicators 2-4 and 6-22, the "Checklist for Prevention and Management of Unplanned Hypothermia in Gynecological Surgery Patients" was formulated, and the nurses' implementation of the best evidence was evaluated through data analysis after clinical implementation; and (3) Questionnaire survey method: Based on the implementation of the examination indicators, a questionnaire on nurses' knowledge and practice was designed and prepared and distributed by the head nurse to the nurses to complete.

Statistical methods: SPSS 20.0 statistical software and Excel software were used for data entry and analysis. The quantitative data that conformed to a normal distribution are described by means \pm standard deviations, and between-group comparisons were made by the *t* test; count data are described as frequencies and percentages, and chi-square tests were performed to identify differences between groups. All analyses relied upon a $P < 0.05$ statistical significance criterion.

RESULTS

General information

A total of 49 nurses (16, 13, and 20 nurses in the gynecological operating room, anesthesiology department, and gynecology department, respectively), including 44 females and 5 males aged 22-50 (32.1 ± 5.9) years, were investigated before and after the application of this scheme. Most of the nurses had bachelor's degrees (87.76%) and professional titles (67.35%). Thirty patients each were included before and after evidence application, and no significant intergroup differences were identified in terms of age, sex, length of hospital stay, education level, occupation, payment method of medical expenses, or operation duration ($P > 0.05$).

Incidence of hypothermia

The incidence of hypothermia among gynecological perioperative patients decreased from 43.33% to 13.33% after the application of the scheme, with statistical significance ($\chi^2 = 12.381$, $P < 0.001$).

Implementation rate of examination indicators

After the application of evidence, the implementation rate of examination indicators 6-10, 12, 14, 16-18, and 21-22 reached 100%; in addition to indicators 5 and 13 with an implementation rate of 66.67%, the implementation rate of other indicators was 90% or above. Except for indicators 10, 12, and 18, whose implementation rate had been 100% before evidence application, all the other indicators were significantly improved after evidence application ($P < 0.05$) (Table 6).

Nurses' awareness of PH prevention and management in gynecological patients

After the application of the EBP project, the nurses' awareness of PH prevention and management in gynecological patients increased from 60.96 ± 9.70 to 88.08 ± 8.96 , with a statistically significant difference ($t = -29.866$, $P < 0.001$).

Perioperative thermal comfort level of patients undergoing gynecological surgery

The total score of the perioperative thermal comfort level of gynecological surgery patients was 27.97 ± 2.04 after the application of the EBP project, which was statistically significant compared with the score of 21.27 ± 1.57 established by

Table 6 Comparison of nurses' implementation of examination indicators before and after application of the evidence-based program

Examination indicators	Before evidence application (n = 30)			After evidence application (n = 30)			χ^2	P value
	Implemented	Unimplemented	Implementation rate (%)	Implemented	Unimplemented	Implementation rate (%)		
Indicator 1	16	14	53.33	28	2	93.33	12.273	< 0.001
Indicator 2	15	15	50.00	29	1	96.67	20	< 0.001
Indicator 3	12	18	40.00	28	2	93.33	19.2	< 0.001
Indicator 4	0	30	0.00	27	3	90.00	49.091	< 0.001
Indicator 5	7	23	23.33	20	10	66.67	11.38	0.001
Indicator 6	15	15	50.00	30	0	100.00	20	< 0.001
Indicator 7	12	18	40.00	30	0	100.00	25.714	< 0.001
Indicator 8	15	15	50.00	30	0	100.00	20	< 0.001
Indicator 9	11	19	36.67	30	0	100.00	27.805	< 0.001
Indicator 10	29	1	96.67	30	0	100.00	1.017	0.313
Indicator 11	6	24	20.00	27	3	90.00	29.697	< 0.001
Indicator 12	28	2	93.33	30	0	100.00	2.069	0.15
Indicator 13	7	23	23.33	20	10	66.67	11.38	0.001
Indicator 14	3	27	10.00	30	0	100.00	49.091	< 0.001
Indicator 15	4	26	13.33	28	2	93.33	38.571	< 0.001
Indicator 16	14	16	46.67	30	0	100.00	21.818	< 0.001
Indicator 17	11	19	36.67	30	0	100.00	27.805	< 0.001
Indicator 18	30	0	100.00	30	0	100.00	-	-
Indicator 19	21	9	70.00	29	1	96.67	32.308	< 0.001
Indicator 20	12	18	40.00	28	2	93.33	19.2	< 0.001
Indicator 21	10	20	33.33	30	0	100.00	30	< 0.001
Indicator 22	0	30	0.00	30	0	100.00	60	< 0.001

researchers before the intervention ($t = 13.693$, $P < 0.001$).

Perioperative psychological status of patients undergoing gynecological surgery

The total score of the perioperative HAMD of gynecological surgery patients was 4.30 ± 1.15 after the application of the EBP project, which was statistically significant compared with the score of 15.03 ± 3.16 established by researchers before the intervention ($t = 17.500$, $P < 0.001$); the total HAMA score decreased from 13.93 ± 2.64 before the intervention to 3.53 ± 0.78 after the intervention, with statistical significance ($t = 20.713$, $P < 0.001$).

Perioperative cognitive function of patients undergoing gynecological surgery

The total MoCA score among gynecological surgery patients was 26.93 ± 1.11 after the application of the EBP project, which was statistically significant compared with the score of 23.17 ± 1.68 established by researchers before the

intervention ($t = 10.226$, $P < 0.001$).

DISCUSSION

The EBP project based on an MDT was scientific and feasible

A top-down literature search according to the "6S" retrieval model was conducted in this study, as well as rigorous study screening and quality evaluation. The quality evaluation results of the included documents were all high, which ensured the reliability of the evidence sources. To make the summarized evidence of MDT nursing of gynecological patients at different stages of the perioperative period feasible, appropriate, effective and clinically significant, this study followed the FAME principle and invited relevant stakeholders (clinical practitioners) from gynecology, anesthesiology and the operating room to participate in the evidence selection process, which enhanced the clinical practitioners' recognition of the evidence[23]. In addition, relevant experts were invited for consultation, and the clinical experience of clinical decision-makers, managers and practitioners was combined with the clinical evidence application sites, such as the operating room, gynecology and anesthesiology, so that the examination indicators were practical in clinical work. Moreover, based on continuous quality improvement advocated by the KT model and drawing on the i-PARIHS framework (which takes into account all issues that need to be considered, evaluated and planned in the process of evidence application and has been effectively applied in clinical practice as a theoretical framework to guide quality improvement and for the identification of prestudy barrier factors and facilitating factors[22]), this study analyzed the barriers and facilitators in the application of evidence related to the prevention and management of PH in gynecological patients in pilot wards. After determining the major barriers, action strategies were drawn up, and evidence-based intervention programs were formed. The whole process is standardized and scientific, which makes the EBP project scientific and feasible.

The MDT-based EBP project improved the implementation rate of examination indicators and enhanced nurses' awareness of hypothermia prevention and management

Based on the KT model, this EBP project transformed the evidence into clinical practice, formulated an intervention plan for PH prevention and management suitable for local gynecological surgery patients, and filled the relevant vacancies in the pilot operating room. Through the analysis of barriers, tailored action strategies were formed, contributing to the increase in the scores of ward nurses, operating room nurses and anesthesia nurses on PH prevention and management in gynecological patients from 60.96 ± 9.70 to 88.08 ± 8.96 and the increase in the examination indicator implementation rate from 0-100% to 66.67-100%, which was significantly improved compared with the values before evidence application ($P < 0.05$). This suggests that the EBP project enhanced the awareness of hypothermia prevention and management among nursing staff, especially gynecological nurses, and that most of the evidence was well applied in clinical practice. This may be related to the construction of practice plans, the implementation of action strategies and quality supervision, which clarified the job responsibilities and standardized the behavior of nurses, thus promoting changes in clinical practice, consistent with the results of a number of studies[24,25].

The EBP project based on an MDT reduced the incidence of PH in gynecological patients

The necessity and importance of the prevention and management of PH in surgical patients, an important part of operating room care, have been emphasized in the guidelines[13,14] when selecting the best evidence in this study. After the implementation of this EBP project, the incidence of PH in gynecological patients in the pilot wards decreased from 43.33% to 13.33%, and the score of perioperative thermal comfort level increased from 21.27 ± 1.57 to 27.97 ± 2.04 , with statistical significance. It is suggested that the EBP project can effectively reduce the incidence of PH in gynecological patients and improve their thermal comfort level, similar to the findings of Xiao *et al*[26]. This may be related to the fact that this EBP project takes evidence-based evidence as the theoretical basis, implements patient-centered and multidisciplinary cooperation, and focuses on temperature management of gynecological patients throughout the perioperative period, including gynecology, operating room and PACU. The specific measures include giving health education about body temperature to patients and their families before and after surgery in gynecological wards; conducting preoperative hypothermia risk assessment and preinsulation in the operating room; using a lithotomy position-dedicated inflatable heating blanket during the operation according to the characteristics of commonly used lithotomy positions for gynecological patients, which can effectively cover the whole body of the patient with a better heating effect compared with the whole-body inflatable heating blanket in the supine position[27]; implementing comprehensive warm-keeping measures such as intravenous infusion and transfusion heating, lavage fluid heating and continuous body temperature monitoring; emphasizing continuous body temperature monitoring and passive thermal insulation when patients are in the PACU; performing temperature monitoring and active thermal insulation measures of abnormal hypothermia in the gynecological ward 24 h after surgery; and paying attention to the patient's thermal comfort level during the whole perioperative period. However, due to the short application time of evidence in this study and the small number of patients included, the effectiveness of this protocol needs validation through continuous application.

The EBP project based on an MDT improved the psychological status and cognitive function of gynecological patients during the perioperative period

In this study, the psychological status of gynecological patients during the perioperative period was evaluated by the HAMD and HAMA, and cognitive function was assessed by the MoCA. Before the implementation of the MDT-based

EBP project, gynecological perioperative patients suffered from varying degrees of negative emotions and cognitive impairment. Negative emotions such as anxiety and depression were significantly alleviated after the implementation of the MDT-based EBP project, and cognitive function was also significantly improved, mainly manifested in the significant reduction in HAMD and HAMA scores and the significant increase in MoCA scores. The above results suggest that the EBP project based on MDTs can effectively improve the psychological status and cognitive function of gynecological patients during the perioperative period. This may be attributed to the identification of potential psychological distress in perioperative gynecological patients and psychological interventions in the MDT-based EBP project. In addition to hypothermia prevention and thermal comfort intervention in the wards 24 h after surgery, the relevant members of the evidence-based team were also required to pay close attention to the psychological changes of patients and provide timely relief and comfort to minimize their negative emotions. At the same time, it is also necessary to give careful attention and patient answers to problems that may cause psychological distress to patients, which helps patients establish a positive psychological attitude and improve their compliance with relevant EBP steps. In the study of Meng *et al*[28], the application of an EBP project based on MDT to postpartum anxiety and depression also significantly reduced adverse mood and improved patients' nursing satisfaction, which supports our findings. Another study pointed out that the EBP project based on MDT can assist patients undergoing gynecological laparoscopic surgery with propofol and fentanyl to improve their mental health, similar to our research results[29]. Dai *et al*[30] also reported that evidence-based nursing interventions based on MDTs are beneficial for improving the cognitive function of patients in intensive care units, which is mainly reflected in significantly increased Mini-Mental State Examination scores and a reduced incidence of delirium after intervention, which is consistent with our research results. In this study, the improvement in cognitive function in gynecological perioperative patients by the MDT-based EBP project may be related to its effective reduction in the incidence of hypothermia.

MDTs facilitate the effective management of PH in gynecological patients

Munday *et al*[7] reported that intervention strategies based on the MDT model can maximize the effect of PH prevention and management. Drawing on the i-PARIHS framework, this study found that communication was blocked in the prevention and management of PH in gynecological patients among nurses from different departments. At present, there is a fault segmentation in the temperature management of patients in the operating room, gynecological ward and PACU, and patient transport and handover are neglected. To solve this obstacle, the EBP project established a multidisciplinary collaboration team led by nurses, clarified the division of team roles, detailed the professional responsibilities of the preoperative ward, preoperative preparation room, intraoperative operating room, postoperative PACU, and postoperative 24-hour gynecological ward in the prevention and management of hypothermia throughout the perioperative period of gynecological patients, and set up a WeChat communication group to ensure smooth and timely response of information among disciplines, thus promoting communication and cooperation among multiple disciplines, which was consistent with the research results of Shi *et al*[31]. In addition, the body temperature supervision mechanism and the overall quality control process led by the head nurses of the operating room, gynecology and anesthesiology departments were improved. Furthermore, the head nurses reported the practice changes to the evidence-based team monthly to allow for time identification of barriers and facilitators. Moreover, the evidence-based team conducted a quality inspection every quarter to solve problems such as nurses' inadequate assessment of hypothermia risk factors, insufficient supply of 38-40 °C irrigation solution during operations, and inadequate adjustment of ambient temperature to ensure reasonable, feasible and perfect implementation of all aspects and further promote the effective management of PH in gynecological patients. MDTs can integrate medical resources and lead patients to better rehabilitation outcomes [32].

The MDT-based EBP project needs further continuous improvement

The KTA model emphasizes the continuous use and consolidation of knowledge[8], that is, continuous quality improvement of the project after implementation and evaluation. The commonly used quality improvement models are PDCA circulation and quality control circles, which have been widely applied in medical and nursing fields and have achieved remarkable results in advocating medical and nursing quality improvement. In this study, the implementation rate of intraoperative temperature monitoring equipment use and intraoperative temperature monitoring every 15 min in gynecological surgery patients was 66.67% after the application of the EBP project, indicating the poor implementation of intraoperative body temperature monitoring and the need for further improvement. This is related to the use of wireless temperature monitoring equipment in the pilot operating room. This device can realize continuous monitoring of core temperature every minute, but there are some problems, such as a high cost of use, discontinuous temperature monitoring due to a weak Bluetooth signal during operations, and equipment failure, which makes some patients refuse to use temperature monitoring equipment, resulting in loss of temperature monitoring values. Patients who refuse to use wireless temperature monitoring equipment have to be monitored manually by visiting nurses every 15 min, which increases the nurses' workload and leads to the low implementation rate of nurses' norms. On the other hand, in this EBP project, although body temperature management of patients in the PACU was strengthened, there was a lack of thermal insulation equipment for patients with hypothermia. Studies have shown that using the modified inflatable thermal insulation quilt for patients with mild hypothermia has the same warming effect as the inflatable heating blanket, which can not only reduce costs but also be suitable for rewarming PACU patients with hypothermia. Therefore, the common quality improvement model can be combined in the future to further optimize PH prevention and management in gynecological patients.

CONCLUSION

This study focused on the high incidence of PH in gynecology. Guided by KT drawing on the best evidence and i-PARIHS framework and combined with the wishes of stakeholders and expert opinions, an EBP project based on an MDT was formulated and implemented, which effectively promoted the application of evidence, strengthened multidisciplinary cooperation, standardized the prevention and management of PH in gynecology, improved nurses' awareness, and effectively enhanced nursing quality. For gynecological patients during the perioperative period, this project lowered the incidence of PH and improved their thermal comfort level, psychological status and cognitive function. However, the implementation effect of some examination indicators was still not satisfactory, and relevant procedures and systems need further optimization. In the future, how to standardize the monitoring of patients' continuous body temperature during surgery needs further discussion.

ARTICLE HIGHLIGHTS

Research background

Perioperative hypothermia (PH) has varying degrees of negative effects on the physical and mental health of patients, and there is no effective multidisciplinary team (MDT) intervention for PH in gynecological patients.

Research motivation

Despite the comprehensiveness and maturity of the practice guidelines and evidence summaries on PH prevention and management in foreign countries, there is a lack of effective clinical practice for PH in gynecological patients in China, so it is necessary to conduct this analysis to fill in this gap.

Research objectives

To apply the best evidence on the prevention and management of PH in gynecological patients, to improve the quality of perioperative evidence-based care based on MDT treatment of gynecological patients, and to analyze the effect of MDT-based evidence-based practice (EBP) project on the psychological status and cognitive function of gynecological patients with PH.

Research methods

Under the guidance of knowledge translation and combined with the opinions of stakeholders involved and clinical experts, the best evidence for PH prevention and management in gynecological patients was selected and adjusted to suit the practice setting. Based on the evidence, the practice plan was developed, and the MDT intervention was carried out in the preoperative ward, the preoperative preparation room, the intraoperative operating room, the postanesthesia care unit, and the 24-hour postoperative gynecological ward through the EBP program. The incidence of hypothermia, the nurses' awareness, the implementation rate of examination indicators, and the thermal comfort level, psychological status and cognitive function of patients were compared before and after the program application.

Research results

The incidence of PH in gynecological patients decreased from 43.33% to 13.33% after the application of the scheme. The implementation rate of examination indicators 6-10, 12, 14, 16-18, 21, and 22 reached 100%, and that of other indicators was above 90% except for examination indicators 5 and 13, which was 66.67%; the indexes were significantly improved compared with the baseline (before evidence application), with statistical significance ($P < 0.05$). The score of nurses' awareness of PH prevention and management in gynecological patients increased from (60.96 ± 9.70) to (88.08 ± 8.96) , and the difference was statistically significant ($P < 0.001$). The total score of perioperative thermal comfort level of patients undergoing gynecological surgery was (27.97 ± 2.04) , which was statistically increased compared with the score of (21.27 ± 1.57) investigated by researchers at baseline ($P < 0.001$). The perioperative Hamilton Anxiety Scale and Hamilton Depression Scale scores of patients undergoing gynecological surgery decreased from (15.03 ± 3.16) and (13.93 ± 2.64) to (4.30 ± 1.15) and (3.53 ± 0.78) , respectively, with statistically significant differences ($P < 0.001$). The perioperative Montreal Cognitive Assessment Scale score of the gynecological surgery patients increased from (23.17 ± 1.68) to (26.93 ± 1.11) , also with statistical significance.

Research conclusions

MDT-based EBP of PH prevention and management in gynecological patients during the perioperative period can standardize nursing operations, improve nurses' awareness and behavioral compliance with gynecological hypothermia management, and reduce the occurrence of PH in gynecological patients, while playing a positive role in reducing patients' negative emotions and enhancing their cognitive function.

Research perspectives

MDT-based EBP has certain effectiveness in perioperative PH prevention and management of gynecological patients and can improve patients' psychological state and cognitive function. However, it is still necessary to solve the problem that the accuracy rate of intraoperative temperature monitoring is less than 80%.

FOOTNOTES

Author contributions: Liu QY designed the study; Liu QY, You TY, Zhang DY and Wang J performed the data collection and conducted the data analysis; Liu QY wrote the manuscript; Liu QY and Wang J revised the manuscript; all authors approved the final version of the manuscript.

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