Original Article

Summary of best evidence on prevention of intracranial infection after endoscopic endonasal transsphenoidal pituitary neoplasm resection

Jing Wang[1#], Ping Yu[2#], Qi Chen[1], Zhijun Han[1], Qing Wang[3], Xiaojie Lu[3], Xuechao Wu[3*], Chun Bian[2*], Mingzhu Gao[1*]

[1]Department of Clinical Research Center, Jiangnan University Medical Center (Wuxi No. 2 People's Hospital), Wuxi School of Medicine, Jiangnan University, Wuxi, China; [2]Department of Nursing, Jiangnan University Medical Center (Wuxi No. 2 People's Hospital), Wuxi, China; [3]Department of Neurosurgery, Jiangnan University Medical Center (Wuxi No. 2 People's Hospital), Wuxi, China

Contributions: (I) Conception and design: X Wu, C Bian, M Gao; (II) Administrative support: Z Han, X Lu; (III) Provision of study materials or patients: X Wu; (IV) Collection and assembly of data: J Wang, P Yu, Q Chen; (V) Data analysis and interpretation: J Wang, P Yu; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

[#]These authors contributed equally to this work as co-first authors.

[*]These authors contributed equally to this work as co-corresponding authors.

Correspondence to: Xuechao Wu, MD. Department of Neurosurgery, Jiangnan University Medical Center (Wuxi No. 2 People's Hospital), No. 68 Zhongshan Road, Wuxi 214000, China. Email: wuxc89@jiangnan.edu.cn; Chun Bian, MD. Department of Nursing, Jiangnan University Medical Center (Wuxi No. 2 People's Hospital), No. 68 Zhongshan Road, Wuxi 214000, China. Email: 446859512@qq.com; Mingzhu Gao, MD. Department of Clinical Research Center, Jiangnan University Medical Center (Wuxi No. 2 People's Hospital), No. 68 Zhongshan Road, Wuxi 214000, China. Email: gaomingzhujewel@163.com.

Background: Intracranial infection is one of the most serious complications after pituitary neoplasm resection. However, the quality of the evidence for existing preventive measures varies significantly, and the related content is scattered, and the scope is broad. Nurses lack the specificity and targeted guidance for preventing intracranial infections after endoscopic endonasal transsphenoidal surgery (EETS), and nurses find that evidence necessitates screening and identification during its application, and it is challenging to utilize current tool for guiding clinical practice. Thus, the protocols for preventing intracranial infection after EETS required further refinement. The aim of this study is to summarize the relevant evidence for preventing postoperative intracranial infections after endoscopic endonasal transsphenoidal pituitary neoplasm resection, in order to reduce the incidence of postoperative intracranial infection and provide a reference for clinical medical staff.

Methods: We systematically searched a variety of platforms, including British Medical Journal Best Practice, UpToDate, DynaMed, Guidelines International Network, Registered Nurses' Association of Ontario, Scottish Intercollegiate Guidelines Network, Australian Joanna Briggs Institute Evidence based Healthcare Center Database, National Institute for Health and Clinical Excellence, Medlive, Wanfang Data, China National Knowledge Infrastructure (CNKI), China Science and Technology Journal Database (VIP), Cochrane Library, Embase, PubMed, Web of Science, and Chinese biomedical literature service system (Sinomed) to collect clinical decisions, relevant guidelines, evidence summaries, systematic reviews, and expert consensus documents on the prevention of intracranial infection in this context according to the 6S evidence model. The search included literature published up to December, 2023. Then conduct literature screening and evaluation, extract and summarize relevant evidence on perioperative prevention of intracranial infection after EETS from the selected literature. Two researchers applied the JBI levels of evidence preappraisal system (2014 version) to categorize the included evidence into five levels (level 1a being the highest and level 5c being the lowest).

Results: A total of 16 pieces of literature were reviewed, including 6 clinical decision-makings, 2 guidelines, 2 systematic reviews, and 6 expert consensus documents. Ultimately, 24 pieces of best evidence

for preventing intracranial infections after EETS for pituitary adenomas were formed, and they will be divided into four categories: multidisciplinary collaboration, preoperative evaluation and informed consent, intraoperative prevention and control, and postoperative observation and prevention.

Conclusions: This summarized the best evidence for preventing intracranial infection after endoscopic endonasal transsphenoidal pituitary neoplasms resection. Summary of the best evidence for preventing intracranial infections following EETS plays a critical role in enhancing surgical success, optimizing patient management, fostering multidisciplinary collaboration, advancing research, and improving patient satisfaction. It is recommended that medical staff select and apply the evidence in clinical practice in order to avoid the occurrence of intracranial infections.

Keywords: Endoscopic endonasal transsphenoidal; pituitary neoplasms resection; intracranial infections; evidence-based nursing; precaution

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Introduction

Pituitary tumors are one of the most common intracranial tumors, accounting for about 15% of all brain tumors (1,2). Surgery is currently the most effective therapy, with a common treatment procedure being endoscopic endonasal transsphenoidal surgery (EETS) (3). This transnasal approach involves a higher potential risk of postoperative intracranial infection, the incidence of intracranial infection during EETS is 4% (4). Intracranial infection is one of the most severe complications following brain surgery. In mild cases, symptoms such as fever and headache may occur, while severe cases can lead to increased intracranial pressure, induce brain herniation, or even death (5). Currently, the focus of research on the management of postoperative intracranial infections includes primary nursing preventive measures, which involves thorough preoperative nasal cleansing, strict aseptic protocols during surgery, and appropriate postoperative patient positioning (6), among other measures. However, these intervention and management strategies have developed from comprehensive nursing care for diseases and nursing measures for other complications, the quality of the evidence supporting these practices varies significantly, the related content is scattered, and the scope is broad. They lack the specificity and targeted guidance for preventing intracranial infections after EETS surgery. Consequently, nurses find that evidence necessitates screening and identification during its application, and it challenging to utilize current tool for guiding clinical practice. Thus, the protocols for preventing intracranial infection after EETS required further refinement. This study thus aimed to use evidence-based nursing research methods, search for relevant literature at home and abroad, conduct literature screening and evaluation, extract and summarize relevant

Highlight box

Key findings

- Adequate nasal examination and preparation should be conducted before surgery.
- The blood glucose levels in patients with diabetes should be actively controlled before surgery to maintain stability.
- Reasonable use of antibiotics during surgery.
- Postoperative monitoring and care should be implemented in a timely fashion.
- After surgery, sneezing, violent coughing, straining during bowel movements, and other factors that may induce cerebrospinal fluid leakage should be avoided as much as possible. If constipation occurs, it should be treated in a timely manner.

What is known and what is new?

- Numerous studies on comprehensive postoperative care and complication management for pituitary tumors have reported various nursing interventions aimed at preventing postoperative intracranial infections.
- Our research is based on an evidence-based approach and elaborates on measures to prevent postoperative intracranial infections from four aspects.

What is the implication, and what should change now?

- A comprehensive evaluation of the patient should be conducted during the perioperative period, and timely treatment should be carried out based on the evaluation results.
- This best evidence can help guide clinical practice and reduce the incidence of postoperative intracranial infections.

evidence on perioperative prevention of intracranial infection after EETS from the selected literature. It is hoped these findings can provide a basis for informing the practices of clinical personnel.

Methods

Question identification

This study is based on the PIPOST (Population, Intervention, Professionals, Outcome, Setting, Type of Evidence) model from the Joanna Briggs Institute (JBI) Center for Evidence-Based Health Care in Australia to construct evidence-based questions. In our review model, the components of PIPOST were as follows: the population was the patients undergoing EETS; the intervention was the measures used to prevent intracranial infection; the professionals included neurosurgical clinical medical staff and operating room nursing personnel; the outcomes were the decrease in the incidence of intracranial infections in patients, alleviation of infection-related indicators (e.g., a reduction in the incidence of postoperative fever, improvement in laboratory indicators), an increase in the cognitive level of nursing personnel's knowledge related to preventing intracranial infections, and an improvement in the execution rate of review indicators; the setting (the place where evidence is applied) was the neurosurgery ward and operating room, etc.; and the type of evidence included articles on clinical decision-making, guidelines, evidence summaries, systematic reviews, expert consensus, etc. This evidence summary has been registered at the Fudan University Center for Evidence-Based Nursing (no. ES20244379).

Retrieval strategy

According to the 6S resource model (7), evidence retrieval is searched from the top-down of the pyramid, starting with 'systems' in the 6S model, followed by summaries, synopses of syntheses, syntheses, synopses of studies, and finally considering studies. The search timeframe is from database inception to December 2, 2023. Boolean logic operations were used, and subject words were combined with free words were used to search the following databases: British Medical Journal Best Practice, UpToDate, DynaMed, Guidelines International Network, Registered Nurses' Association of Ontario, Scottish Intercollegiate Guidelines Network, Australian Joanna Briggs Institute (JBI) Evidence based Healthcare Center Database, National Institute for Health and Clinical Excellence, Medlive, Wanfang Data, China National Knowledge Infrastructure (CNKI), China Science and Technology Journal Database (VIP), Cochrane Library, Embase, PubMed, Web of Science, and Chinese biomedical literature service system (Sinomed). The English-language search terms were "pituitary neoplasms/pituitary tumor", "intracranial infection/postoperative intracranial infection/complication/neurosurgical central nervous system infections/NCNSIs/perioperative infection/surgical site infection/SSI", "management/system assessment/meta/guide/guideline/summary of evidence/syntheses", and "transsphenoidal surgery/endoscopic transsphenoidal surgery/transsphenoidal/EETS". The Chinese-language search terms were "pituitary tumor/pituitary neoplasm/pituitary adenoma/brain pituitary adenoma", "intracranial infection/postoperative intracranial infection/complications/surgical site infection/perioperative infection", "guideline/systematic review/meta-analysis/evidence summary/consensus/randomized controlled trial/randomized controlled experiment/evidence synthesis/RCT". A representative search strategy, with PubMed being used as an example, is shown in Supplemental file 1.

Literature inclusion and exclusion criteria

The inclusion criteria for the literature were as follows: (I) literature on the measures to prevent postoperative intracranial infection in patients undergoing EETS; (II) clinical decision-making articles, guidelines, evidence summaries, systematic reviews, or expert consensus documents; and (III) Chinese- or English-language literature. Meanwhile, the exclusion criteria were as follows: (I) literature with a quality evaluation grade of C; (II) interpretations of guidelines, abstracts, translation-type literature, or conference proceedings; and (III) a lack of full text availability.

Criteria for literature quality evaluation

The quality assessment of literature was independently conducted by two researchers (J.W., Q.C.) from the evidence-based team, who received training in evidence-based nursing practice. They used evaluation tools and cross-check each other's work. In case of disagreement, a third researcher (P.Y.) was appointed to provide a final assessment on the quality of the literature. The selection of literature quality assessment tools was based on the type of

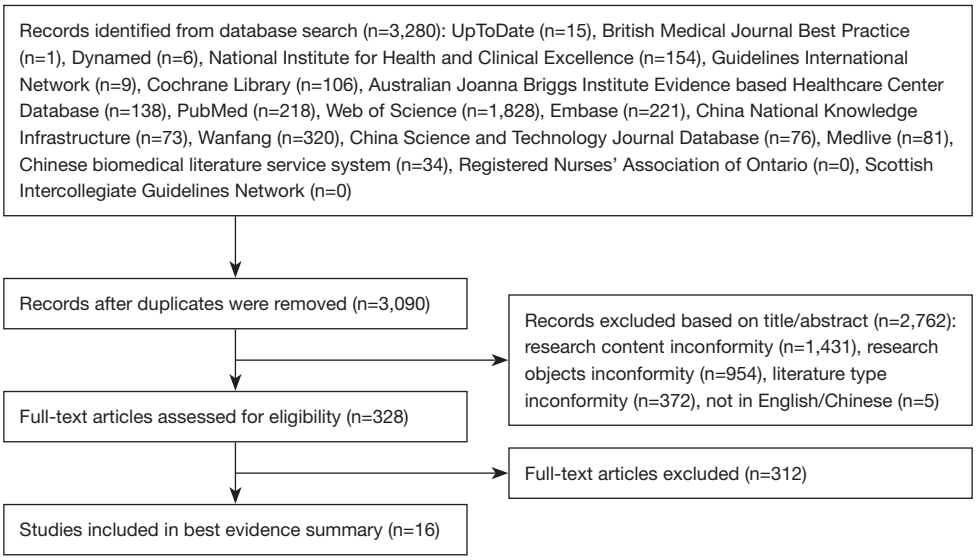

Figure 1 Flowchart of the literature screening process.

literature. For guideline quality assessment, the Appraisal of Guidelines for Research and Evaluation II (AGREE II) system was used. The clinical decisions were evaluated using the Critical Appraisal for Summaries of Evidence (CASE), which includes 10 evaluation items. Each item has the following three options: "yes", "partial yes", and "no", and JBI's corresponding evaluation criteria were applied based on the type of original literature. Quality assessments of expert consensus and systematic reviews were also based on the literature quality assessment tools from the JBI (8).

Evidence quality evaluation

Two researchers (J.W., Q.C.) independently read the included literature and extracted evidence item by item, which was then checked and classified by a third researcher (P.Y.), and finally summarized. During the integration process of evidence content, when evidence was complementary to each other, it could be fused into a single piece of evidential information according to the logical relationship of the evidence; when the content of evidence conflicted, it was necessary to follow the principle of giving priority to the most recently published authoritative literature, evidence-based evidence, and high-quality evidence (9).

Two researchers (J.W., Q.C.) applied the JBI levels of evidence preappraisal system (2014 version) to categorize the included evidence into five levels (level 1a being the highest and level 5c being the lowest) (10). The original classification of evidence directly derived from guidelines and evidence summaries was adopted; if a piece of evidence originated from multiple documents, the classification of the highest quality, highest level, and most recently published evidence was selected as the evidence level (11).

Results

General characteristics of the included literature

A total of 3,280 articles were retrieved, and after deduplication, full-text review, and evaluation, 16 articles (12-27) were ultimately included. The literature and screening process are shown in *Figure 1*, and the general characteristics of the included literature are shown in *Table 1*. Among the 16 pieces literature, 6 articles were on clinical decisions, 2 were guidelines, 2 were systematic reviews, and 6 were expert consensus documents.

Quality evaluation results of the included studies

Quality evaluation results of the clinical decision articles

This study included a total of six clinical decision articles (12-17). We retrieved the original literature for evaluation according to the corresponding evaluation criteria (8). The evaluation results for all the items were "yes". The study designs were complete, the overall quality was high, and these studies were approved for inclusion.

Table 1 General information about the included articles

Authors	Publication year	Literature source	Evidence type	Title
Anderson *et al.* (12)	2022	UpToDate	Clinical decision	Overview of control measures for prevention of surgical site infection in adults
Swearingen *et al.* (13)	2023	UpToDate	Clinical decision	Transsphenoidal surgery for pituitary adenomas and other sellar masses
Susmeeta *et al.* (14)	2023	Best Practice	Clinical decision	Pituitary adenoma
Troyan *et al.* (15)	2023	DynaMed	Clinical decision	Surgical site infection-prevention
Tritos *et al.* (16)	2023	DynaMed	Clinical decision	Nonfunctioning pituitary adenoma
Hanna *et al.* (17)	2021	DynaMed	Clinical decision	Transsphenoidal surgery for pituitary tumors
Wang *et al.* (18)	2023	WOS	Guidelines	Evidence-based guideline for the prevention and management of perioperative infection
Ren *et al.* (19)	2019	Medlive	Guidelines	Chinese guideline for the prevention of surgical site infection
Moldovan *et al.* (20)	2019	WOS	Systematic review	A systematic review of prophylactic antibiotic use in endoscopic endonasal transsphenoidal surgery for pituitary lesions
Tan *et al.* (21)	2020	WOS	Systematic review	Intraoperative lumbar drainage can prevent cerebrospinal fluid leakage during transsphenoidal surgery for pituitary adenomas: a systematic review and meta-analysis
Zhu *et al.* (22)	2022	Medlive	Expert consensus article	Chinese expert consensus on standardized management of cerebrospinal fluid leakage
Hong *et al.* (23)	2020	Wanfang	Expert consensus article	Expert consensus on skull base reconstruction techniques in endoscopic transnasal skull base surgery
Wang *et al.* (24)	2021	Medlive	Expert consensus article	Consensus of Chinese experts on the diagnosis and treatment of central nervous system infection in neurosurgery (2021 Edition)
Zhang *et al.* (25)	2022	Wanfang	Expert consensus article	Chinese expert consensus on the diagnosis and treatment of central nervous system infections after endoscopic transnasal skull base surgery
Wei *et al.* (26)	2017	Medlive	Expert consensus article	Consensus among experts in the diagnosis and treatment of infections in critically ill neurosurgical patients in China
Wang *et al.* (27)	2019	WOS	Expert consensus article	ICAR: endoscopic skull-base surgery

WOS, Web of Science; ICAR, International Consensus Statement on Allergy and Rhinology.

Quality evaluation results of the guidelines

This study included two guidelines (18,19), which were evaluated using the AGREE II quality assessment. The recommendations in the guidelines were all rated as level A, and the results of the quality assessment are shown in *Table 2*.

Quality evaluation results of the systematic reviews

This study included two systematic reviews (20,21). Among them, the study by Moldovan *et al.* (20) was assessed as "No" for item 7 ("Taking certain measures to reduce errors when extracting data"), while all other items were evaluated as "Yes"; all evaluation items in the study by Tan *et al.* (21) were assessed as "Yes". The design of both studies was relatively complete, with a high overall quality evaluation, and they were both included.

Quality evaluation results of the expert consensus documents

This study included six expert consensus document (22-27). Among them, the study by Zhang *et al.* (25) was evaluated as "No" for item 5 ("Did it refer to other existing literature?"), and all other items were evaluated as "Yes"; the remaining

Table 2 Quality evaluation results of guidelines (n=2)

Authors	Standardized scores by field (%)						Number of fields ≥60%	Number of fields ≥30%	Overall quality
	Scope and purpose	Participants	Preciseness	Clarity	Applicability	Independence			
Wang *et al.* (18)	100	100	92	100	95	100	6	6	A
Ren *et al.* (19)	100	100	88	100	85	100	6	6	A

five studies (18-20,22,23) were all evaluated as "Yes" for all evaluation items. The overall quality evaluation of the six expert consensus documents was high, and they were all included.

Evidence summary and description

We summarized the evidence for the prevention of intracranial infection after EETS according to four categories: multidisciplinary collaboration; preoperative assessment and informed consent; intraoperative prevention and control; and postoperative observation, prevention, and control. From the included literature, the 24 best pieces of evidence were synthesized, as shown in *Table 3*.

Discussion

Multidisciplinary collaboration

Evidence item 1 emphasizes that the incidence of postoperative intracranial infections can be reduced through multidisciplinary cooperation. A multidisciplinary team can consist of endocrinologist, neurosurgeons, surgical teams, and ward nurses (18,21). The endocrinologist is responsible for monitoring and assessing patients' pituitary-related hormone functions and controlling blood glucose levels during the perioperative period, the neurosurgeon oversees the patient's entire course of diagnosis and care, and the surgical team manages the surgical procedure. Marques *et al.*'s (28) research shows that by providing multidisciplinary care to patients, the length of hospital stay and incidence of complications can be reduced. Through multidisciplinary rounds and related medical activities, nurses can gain a deeper understanding of the patient's treatment plan and become familiar with possible complications, which helps them make precise and early nursing judgments and be alert to warnings regarding changes in the patient's condition. Hospital administrators should strengthen systematic training for relevant personnel, organize regular training assessments, and ensure that personnel master the related knowledge and skills, thereby reducing the incidence of intracranial infections.

Preoperative evaluation and informed consent

Evidence items 2–7 encompass the relevant assessments that patients should undergo before operation, including medical history, potential comorbidities, and nasal cavity evaluation. The central nervous system being exposed to a contaminated nasal pathway can result in retrograde meningitis in patients. The evidence suggests that effective management of the patient's nasal passages before surgery, such as appropriate trimming of nasal hair, control of rhinitis, and evaluation of nasal cavity condition, can significantly reduce the incidence of postoperative intracranial infections (6,25,26,29). Asori *et al.*'s (30) reported that patients with diabetes have weakened immunity and are prone to incision infections, which can increase the risk of intracranial infection. In patients with diabetes mellitus, it is crucial to closely monitor and maintain the patient's blood glucose levels and immune function to prevent the occurrence of intracranial infections. The prophylactic use of antibiotics plays a vital role during the perioperative period, effectively reducing the incidence of postoperative intracranial infections (31), and thus it is appropriate to use safe and cost-effective antimicrobial drugs preoperatively.

Evidence item 8 recommends that neurosurgeons and endocrinologists should jointly explain to the patient the possible complications and prognostic outcomes of the surgery and obtain informed consent from the patient. Siegel *et al.*'s research shows that the higher the patient's compliance, the better the prognosis (32).

Intraoperative prevention and control

Evidence items 9–18 outline measures for the prevention and control of intracranial infection during surgery. Intraoperative bleeding is one of the main risk factors for

Table 3 Summary of best evidence for preventing intracranial infection after endoscopic endonasal transsphenoidal pituitary neoplasm resection

Evidence item	Content of evidence	Evidence level
Multidisciplinary collaboration	A multidisciplinary team should consist of neurosurgeons, endocrinologists, radiologists, radiation oncologists, anesthesiologists, neurosurgical nurses, and operating room nurses (16)	3c
Preoperative evaluation and informed consent	Preoperatively, the patient's medical history should be investigated, including symptoms related to sinusitis such as rhinorrhea, nasal congestion, and epistaxis (13,14). If the patient has sinusitis, it should be actively treated and controlled (25)	2b
	Patients should undergo a nasal examination before surgery for assessment of the structure of the nose and the condition of the mucous membrane and to optimize the surgical approach (13,17)	3e
	The patient should be assessed for potential comorbidities such as diabetes, hypertension, and heart failure (13,14)	2d
	In patients with diabetes, blood glucose levels should be actively controlled before surgery to maintain stability, with the target blood glucose level being 6.1–8.3 mmol/L (12,15,21)	1c
	Preoperative nasal preparation should be thoroughly conducted (13,17,26,27)	1a
	Preoperative use of safe and inexpensive antimicrobial agents for prophylaxis is appropriate (15,16,22)	1a
	Preoperatively, patients should be thoroughly informed of potential surgical complications and prognostic outcomes by both neurosurgeons and endocrinologists in obtaining their informed consent (14)	3b
Intraoperative prevention and control	The patient can be positioned in the reverse Trendelenburg position during surgery, which can effectively reduce intraoperative bleeding (14)	1c
	A facial exposure area for the patient is appropriate for avoiding potential contamination (14)	2c
	Normal body temperature should be maintained in patients during the perioperative period (15)	1a
	The requirements of "Surgical Hand Disinfection Techniques" should be strictly adhered to according to the principles of asepsis during surgery (12,18,19,26)	1c
	The number of times personnel move in and out of the operating room during surgery should be minimized (18)	1d
	During surgery, 0.05% povidone-iodine and 3% hydrogen peroxide solution can be alternately used to rinse the nasal passages (20,25)	1a
	The surgical field should be maintained with saline irrigation at a temperature of 34–37 ℃ throughout the procedure (25)	3b
	Antibiotics should be administered intravenously 30 minutes before the start of surgery or during the induction of anesthesia and be completed within 30 minutes. If the surgery extends beyond 3 hours, or if blood loss exceeds 1,500 mL (24), a supplementary dose can be administered intraoperatively (18)	1a
	After tumor resection, cranial base reconstruction must be performed, with the distinct properties of various materials being leveraged to partition and seal the cranial base in order to reduce the risk of postoperative cerebrospinal fluid leakage and related complications (22,23)	1a
	During surgery, when a cerebrospinal fluid (CSF) leak is definitively identified, appropriate repair methods can be selected based on the volume of CSF leakage (22,27)	2b
Postoperative observation, prevention, and control	After the patients awaken from anesthesia, it is recommended that they maintain a head-up position with the upper body elevated 20–30° (22-23).	2b
	Timely postoperative monitoring and care should be applied, including neurological system assessment and monitoring, blood tests, consciousness level, blood pressure, headache, nosebleeds, cerebrospinal fluid leakage, etc. (17)	1a

Table 3 (*continued*)

Table 3 (*continued*)

Evidence item	Content of evidence	Evidence level
	If a patient is found to be coughing, complaining of itching, or with a salty fluid flowing down and a foreign body sensation in the posterior pharyngeal wall, it should be reported to the doctor in a timely manner, and secretions should be collected for testing (17)	1a
	After surgery, sneezing, violent coughing, straining during bowel movements, and other factors that may induce cerebrospinal fluid leakage should be avoided as much as possible. If constipation occurs, it should be intervened in a timely manner (25)	1a
	If an external ventricular drain is placed, aseptic maintenance should be observed to prevent possible iatrogenic contamination. The volume of drainage should be 150–200 mL/d. If the patient's condition permits, the drain should be removed as soon as possible. The duration of placement should not exceed 2–3 weeks, and a new tube should be replaced as necessary (24,26)	1a
	Depending on the different methods of skull base reconstruction, the duration of postoperative nasal packing should be minimized as much as possible. If there is no significant exudate, the nasal packing should be removed as soon as possible, and the maximum packing time should not exceed 2 weeks (23)	1a

postoperative intracranial infection (31), and the reverse Trendelenburg position can reduce intracranial bleeding during surgery (14). Koc *et al.* (33) found that a 20° reverse Trendelenburg position results in the lowest blood loss and does not affect the surgical technique or the surgical field of view. Additionally, the use of warm saline irrigation during surgery can effectively dilute mucus in the nasal cavity, maximally remove residual tissue and blood, and ensure a clear surgical field of view. Other research (34) indicates that continuous irrigation of the surgical area and nasal passages during surgery can reduce the risk of intracranial infection (25). The operating room should be set to an appropriate environmental temperature (22–25 ℃), unnecessary exposure of the skin should be minimized during surgery, and the irrigation fluid used should be preheated to 37 ℃ to prevent perioperative hypothermia in patients (25). Surgeons and instrument nurses must strictly adhere to aseptic protocols, standardize preoperative skin preparation and disinfection management of the surgical area, and minimize personnel movement in and out of the operating room during the procedure (29).

The longer the operation is, the longer the surgical incision is exposed, increasing the risk of surgical site infection and, consequently, the risk of postoperative intracranial infection (31,35). Therefore, if the duration of the surgery is extended, the use of antibiotics should be considered to prevent postoperative intracranial infection (21). The prevention of cerebrospinal fluid leaks is more important than treatment, and timely detection and repair of defects during surgery are key measures in preventing cerebrospinal fluid leaks. Cranioplasty is the most crucial operation for preventing postoperative intracranial infection in patients, with vascularized nasoseptal flaps or fascia and subcutaneous fat from the thigh generally being the preferred filler materials (36). Removed fat, fascia, or muscle tissue should be stored in sterile containers to prevent secondary contamination (27).

Postoperative observation, prevention, and control

Evidence items 19–24 pertain to postoperative observation, prevention, and control, including patient's postoperative positioning, monitoring parameters, patient precautions, lumbar cistern drainage precautions, and the removal of nasal packing. Cerebrospinal fluid leak is an independent risk factor for intracranial infection (31), and thus it is essential to prevent the occurrence of cerebrospinal fluid leak postoperatively. After the operation, patients should be placed in a semireclining position with the head elevated 20–30°. This helps reduce intracranial pressure and the drainage of residual fluid from the nasal cavity, decreasing the incidence of cerebrospinal fluid leak (22,23), and increase patient comfort. To counteract the impact of cerebrospinal fluid on cranial base defects, reducing cerebrospinal fluid exudation and preventing nasal mucosa adhesion and bleeding are needed, and effective nasal packing is thus required. However, prolonged nasal packing can cause discomfort in patients, induce sinusitis, and slow the repair of the nasal mucosa. Therefore, selecting the appropriate time to remove the nasal packing can

help reduce the incidence of intracranial infection (27). Postoperative vital signs and levels of consciousness should be promptly monitored, and patients should be informed of the measures for preventing intracranial infection, such as avoiding severe coughing, sneezing, or straining during bowel movements (25). Nurses should explain these measures in an easy-to-understand manner so that patients can grasp the relevant steps to prevent postoperative intracranial infection. Additionally, heightened attention should be paid to changes in the patient's condition through increasing the frequency of rounds. Symptoms such as fever, clear fluid flowing from the nose, or bleeding (29) should be promptly reported to the clinician (6,23). If possible, drainage tube placement should be avoided, as research (26) indicates that patients with prolonged postoperative lumbar pool drainage have a higher rate of intracranial infection than do those without. Drainage tubes should be securely fixed to prevent patients from pulling them out, as this can lead to retrograde infection (24). Nurses should regularly check the amount, color, and consistency of the drainage fluid; if it becomes cloudy, intracranial infection should be considered, and intervention treatment should be promptly administered.

Conclusions

This study summarizes the best evidence for preventing post-EETS intracranial infections from four aspects: multidisciplinary collaboration, preoperative assessment and informed consent, intraoperative prevention and control, and postoperative observation prevention and control. Medical staff can select and apply the best evidence in clinical practice to improve patient outcomes. Since clinical practice based on this assembled evidence has not yet been implemented, the effectiveness and rationality of this evidence summary requires further validation. When translating evidence into clinical practice, medical staff should fully consider clinical conditions and the specific situation of patients, thoroughly analyze obstacles and facilitators to implementing the evidence, and ensure the safety and feasibility its application.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://gs.amegroups.com/article/view/10.21037/gs-24-415/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

1. Deng C, Gu L, Sun J, et al. Intracranial seeding of pituitary neuroendocrine tumor: a case report. Gland Surg 2024;13:1108-15.
2. Gupta S, Hoffman SE, Mehta NH, et al. Elevated risk of recurrence and retreatment for silent pituitary adenomas. Pituitary 2024;27:204-12.
3. Huang Y, Qin L, Lv H, et al. Neuronavigation-assisted pituitary neuroendocrine tumor resection: a systematic review and meta-analysis. Quant Imaging Med Surg 2024;14:5012-27.
4. Bengtsson OF, Sunnergren O, Segerhammar I, et al. Remission, complications, and overall survival in transsphenoidal pituitary surgery-a Swedish single-center experience of 578 patients. Acta Neurochir (Wien) 2023;165:685-92.
5. Velnar T, Kocivnik N, Bosnjak R. Clinical infections in neurosurgical oncology: An overview. World J Clin Cases

2023;11:3418-33.
6. Cossu G, Belouaer A, Kloeckner J, et al. The Enhanced Recovery After Surgery protocol for the perioperative management of pituitary neuroendocrine tumors/pituitary adenomas. Neurosurg Focus 2023;55:E9.
7. Guo Y, Miao X, Hu J, et al. Summary of best evidence for prevention and management of frailty. Age Ageing 2024;53:afae011.
8. Chen P, Bao F, Pompeo E, et al. Summary of the best evidence for the prevention and management of myasthenic crisis after thymectomy. Gland Surg 2024;13:540-51.
9. Wu JY, Li H, Shuai JK, et al. Evidence summary on the non-pharmacological management of sleep disorders in shift workers. Sleep Breath 2024;28:909-18.
10. Wang CQ, Hu Y. JBI evidence pre-grading and evidence recommendation level system (2014 edition). J Nurs Train 2015;30:964-7.
11. Peng X, Xiao P, Liu Y, et al. Summary of best evidence for self-management in postoperative osteoporotic fracture patients. Int J Orthop Trauma Nurs 2024;52:101060.
12. Anderson DJ, Sexton DJ. Overview of control measures for prevention of surgical site infection in adults(EB/OL). (2022-12-05)(2024-02-21). Available online: https://sso.uptodate.com/contents/overview-of-control-measures-for-prevention-of-surgical-site-infection-in-adults search=Overview%20of%20control%20measures%20for%20prevention%20of%20surgical%20site%20infection%20in%20adults&source=search_result&selectedTitle=1%7E150&usage_type=default&display_rank=1
13. Swearingen B. Transsphenoidal surgery for pituitary adenomas and other sellar masses(EB/OL). (2023-04-20)(2024-02-21). Available online: https://sso.uptodate.com/contents/transsphenoidal-surgery-for-pituitary-adenomas-and-other-sellar-masses?search=Transsphenoidal%20surgery%20for%20pituitary%20adenomas%20and%20other%20sellar%20masses&source=search_result&selectedTitle=1%7E150&usage_type=default&display_rank=1
14. Susmeeta ST, Gabriel Z, John C, et al. Pituitary adenoma(EB/OL)(2023-03-30) (2024-02-21). Available online: https://bestpractice.bmj.com/topics/en-gb/1030
15. Troyan SL, Fedorowicz Z, Prasad P. Surgical Site Infection - Prevention(EB/OL)(2023-07-24) (2024-02-21). Available online: https://www.dynamed.com/prevention/surgical-site-infection-prevention
16. Tritos NA, Sivanandy MS, Fedorowicz, et al. Nonfunctioning Pituitary Adenoma(EB/OL)(2023-05-23) (2024-02-21). Available online: https://www.dynamed.com/condition/nonfunctioning-pituitary-adenoma
17. Hanna B, Leung JH, Fedorowicz Z, et al. Transsphenoidal Surgery for Pituitary Tumors(EB/OL). EBSCO Information Services. (2021-09-24)(2024-02). Available online: https://www.dynamed.com/management/transsphenoidal-surgery-for-pituitary-tumors
18. Wang Q, Cao M, Tao H, et al. Evidence-based guideline for the prevention and management of perioperative infection. J Evid Based Med 2023;16:50-67.
19. Ren JA, Wu XW, An YZ, et al. Chinese guideline for the prevention of surgical site infection. Chin J Gastrointest Surg 2019;22:301-14.
20. Moldovan ID, Agbi C, Kilty S, et al. A Systematic Review of Prophylactic Antibiotic Use in Endoscopic Endonasal Transsphenoidal Surgery for Pituitary Lesions. World Neurosurg 2019;128:408-14.
21. Tan J, Song R, Huan R, et al. Intraoperative lumbar drainage can prevent cerebrospinal fluid leakage during transsphenoidal surgery for pituitary adenomas: a systematic review and meta-analysis. BMC Neurol 2020;20:303.
22. Zhu W, Mao Y, Feng H, et al. Chinese expert consensus on standardized management of cerebrospinal fluid leakage. Natl Med J China 2022;102:1057-67.
23. Zhang YZ, Hong T, Li CZ, et al. Expert consensus on skull base reconstruction techniques in endoscopic transnasal skull base surgery. Chin Neurosurg J 2020;36:1081-7.
24. Wang N, Qu X, Zhou JX, et al. Consensus of Chinese experts on the diagnosis and treatment of central nervous system infection in neurosurgery (2021 Edition). Chin Neurosurg J 2021;37:2-15.
25. Zhang YZ, Cao L, Shi GZ, et al. Chinese expert consensus on the diagnosis and treatment of central nervous system infections after endoscopic transnasal skull base surgery. Chin Neurosurg J 2022;38:220-6.
26. Wei JJ, Ma XJ, Zhou DB, et al. Consensus among experts in the diagnosis and treatment of infections in critically ill neurosurgical patients in China. Natl Med J China 2017;97:1607-14.
27. Wang EW, Zanation AM, Gardner PA, et al. ICAR: endoscopic skull-base surgery. Int Forum Allergy Rhinol 2019;9:S145-365.
28. Marques P, Sagarribay A, Tortosa F, et al. Multidisciplinary Team Care in Pituitary Tumours. Cancers (Basel) 2024;16:950.
29. Hanson M, Li H, Geer E, et al. Perioperative management of endoscopic transsphenoidal pituitary surgery. World J Otorhinolaryngol Head Neck Surg 2020;6:84-93.

30. Asori M, Musah A, Gyasi RM. Association of Diabetes with Meningitis Infection Risks: A Systematic Review and Meta-Analysis. Glob Health Epidemiol Genom 2022;2022:3996711.
31. Huang X, Zhang X, Zhou J, et al. Analysis of risk factors and preventive strategies for intracranial infection after neuroendoscopic transnasal pituitary adenoma resection. BMC Neurosci 2022;23:1.
32. Siegel S, Giese S, Honegger J, et al. Exploring potential influencing factors of inadherence to specialist aftercare and long-term medication in patients with acromegaly. Pituitary 2024;27:403-15.
33. Koc EK, Besir A, Tugcugil E, et al. The effects of 5-degree, 10-degree and 20-degree reverse Trendelenburg positions on intraoperative bleeding and postoperative Edemea and ecchymosis around the eye in open rhinoplasty. Am J Otolaryngol 2022;43:103311.
34. Gao B, Han B, Gu G, et al. Intraoperative prevention of nasal mucosal injury and surgical field contamination during single-nostril transnasal endoscopic pituitary adenomas resection. Acta Neurochir (Wien) 2024;166:114.
35. Hu AX, Li J, Yu XW, et al. Risk factors for postoperative infection in patients undergoing transnasal skull base tumor surgery and direct economic loss. Chin J Nosocomiol 2024;34:1534-8.
36. Piscopo AJ, Dougherty MC, Woodiwiss TR, et al. Endoscopic Reconstruction of the Anterior Skull Base Following Tumor Resection: Application of a Novel Bioabsorbable Plate. Laryngoscope 2023;133:1092-8.

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