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Application and Care of Two Kinds of Sphenoid Sinus Packing Materials after Pituitary Tumor Resection with the Transnasal Endoscopic Approach

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Abstract

Background: Neuroendoscopic transsphenoidal approach for resection of pituitary adenomas has the advantages of less damage, fewer complications, and a faster recovery than the traditional approach and has beening favored by neurosurgeons. However, there has no standard method of selecting suitable packing materials after the operation to relieve pain in patients and achieve the ideal hemostatic effect. We compared the postoperative complications and treatment effects of two different packing materials in patients with pituitary adenomas. **Objective**: To investigate the advantages and disadvantages of using a catheter balloon and iodoform gauze for hemostasis in patients undergoing pituitary tumor resection by neuroendoscopic transsphenoidal approach. **Materials and Methods:** We retrospectively analyzed these data of 48 cases treated with pituitary adenoma resection by the single nasal approach from January 2018 to October 2019 in Sun Yat-sen University Cancer Center. According to the type of sphenoid sinus packing material used, these patients were divided into balloon tamponade oppression group (24 cases) and tela iodoformum oppression group (24 cases), respectively. The balloon tamponade oppression group received catheter balloon tamponade oppression hemostasis, and the tela iodoformum oppression group underwent tela iodoformum oppression hemostasis. The outcomes and complications were compared between the two groups in which two kinds of sphenoid sinus packing materials were used for hemostasis after tumor resection by transnasal endoscopic approach. For the catheter balloon compression hemostasis method, on account of the plasticity of the balloon, the volume of water in the balloon can be adjusted according to the size of the patient's own sphenoid cavity. The amount of bleeding and several complications in terms

of discomfort during placement and removal of the packing material, rebleeding after removal of the packing, cerebrospinal fluid rhinorrhea and electrolyte disturbance are compared between the two groups. **Results:** 48 patients were enrolled. The two groups' data of patients were similar in age structure, sex ratio, tumor size at baseline and so on. No complications, such as abscess formation, were found in both groups. The success rate in the compression with catheter balloon group was 100% (24 of 24 patients); and in the iodoform gauze group 83.33% (20 of 24 patients). A catheter balloon was more successful in stopping bleeding at early stage than iodoform gauze. There were no statistically significant differences in the hospitalization stay time, operating day to discharge day and tampon indwelling time ($P > 0.05$). There were also no significant differences in pairwise comparison between the catheter balloon group and iodoform gauze groups in the incidence of cerebrospinal fluid rhinorrhea or electrolyte disturbance between the two groups ($P > 0.05$). The incidence of headache in the catheter balloon group was statistically significantly lower than that in the iodoform gauze group ($P < 0.05$). **Conclusion:** In patients undergoing endoscopic pituitary tumor resection, compression and hemostasis by means of catheterization expansion lead to lower rates of injury and complications and have a good effect, so this method is worthy of being recommended for clinical practice.

Keywords

Sphenoid Sinus, Packing Material, Pituitary Tumor, Nursing

1. Introduction

Pituitary tumors originate from the anterior and posterior lobes of the pituitary gland and the residual cells of the craniopharyngeal duct [1] [2] [3] [4]. Packing materials after pituitary tumor resection in sphenoid sinus cavity are a common procedure to prevent complications such as bleeding and leakage of cerebrospinal fluid [5] [6]. Sphenoid sinus packing gives rise to pressure on the cartilage or bone, contributes to the moist environment to keep physiological processes, serves as a barrier, and initiates physiological hemostatic [7]. Various packing agents have been implied using different materials for this goal [8]. Patients often complained of the painful period of packing as the most difficult part during perioperative period. This has resulted in a series of search for exploring a more suitable packing material [9]. Ideally, sphenoidal sinus packing material can support normal anatomical structures, effectively oppress bleeding while in the nasal cavity, and be easily pulled up without pain [7] [10]. Therefore, medical companies fabricated several types of packing materials to relieve these patients' pain. Sphenoid sinus packing may make the patient uncomfortable, but surgeons preferred to use them due to the risk of bleeding [8]. Although many studies related to packing types in recent years are in the ascendant, application of what types of packing material has not reached consensus. Therefore, new studies are

required to determine the differences between routinely used packing materials. The aim of this study was to compare the postoperative complications and treatment effects of two different packing materials in patients with the transsphenoidal approach.

2. Materials and Methods

2.1. Inclusion and Exclusion Criteria

The inclusion criteria were as follows: The patient's sella turcica magnetic resonance imaging (MRI/ computerized tomography (CT) scan suggested that the sellar area mass lesion was a pituitary adenoma. The patient received surgical treatment via the transnasal endoscopic approach with a single nasal cavity. The postoperative specimen pathology test further confirmed the presence of a pituitary adenoma. The cases were continuous in our center.

The exclusion criteria were as follows: Those patients less than 18 years old or more than 80 years old; patients who could not cooperate with the medical staff or had poor compliance; and patients with vital organ dysfunction or coagulation dysfunction before surgery or a history of pituitary tumor resection were excluded.

2.2. General Information

The study enrolled 48 consecutive patients undergoing pituitary tumor resection via the single nasal cavity sphenoid approach and admitted to our department from January 2018 to October 2019. According to the type of packing material used, these patients were divided into balloon tamponade oppression group and tela iodoformum oppression group with 24 cases in each group. The sex, age, length of stay, and indwelling packing time were compared between the two groups, and there were no significant differences between the two groups ($P > 0.05$) (Table 1).

2.3. Packing Methods

The patients underwent pituitary tumor resection with the single transsphenoidal approach under general anesthesia. After tumor resection was completed, the residual cavity was filled with a gel sponge, and the nasal septum and middle turbinate were reset after the positioning of the wound dressing was checked. In the balloon tamponade oppression group, a balloon catheter with a 14 Foley double cavity was adopted for hemostatic compression. The front end of the catheter with the balloon was trimmed and fixed in the sphenoid sinus cavity. Normal saline (5 - 8 mL) was injected into the balloon. The outer end of the urinary catheter was fixed on the cheek with the 3M glue lift platform method so that a mark was made. The catheter was regularly checked to determine whether the balloon had traces of water leakage. The traditional iodine article spinning and stuffing strips for compression hemostasis were used in the tela iodoformum oppression group.

Table 1. Comparison of the two groups of patients in terms of age, length of hospitalization and time from operation to discharge.

Item	balloon tamponade oppression group	tela iodoformum oppression group	*t*	P
Age	50.29 ± 13.51	47.17 ± 9.91	0.913	0.366
Hospital stay (D)	14.88 ± 2.88	16.71 ± 5.04	1.547	0.129
time from operation to discharge (D)	8.13 ± 1.75	9.54 ± 3.75	1.676	0.103
Packing retention time (D)	7.21 ± 3.34	7.67 ± 3.06	0.583	0.563

D = day.

2.4. Statistical Methods

SPSS24.0 statistical software was used to process all the data. The measurement data are presented as $\bar{x} \pm s$, the t-test was used to compare the means between groups, and the χ^2 test was used to compare the incidence between groups. Significance was defined as a P value of <0.05.

3. Nursing in the Perioperative Period

3.1. Preoperative Nursing

3.1.1. Psychological Intervention

The patients had large physical and psychological burdens due to declines in quality of life, appearance changes and a fear of surgery. The psychiatric nurses were required to conduct individual psychological interviews for patients, evaluate the patient's mood and sleep, and provide psychological relief and relaxation training. Sleep drugs were prescribed for patients with poor moods. Moreover, it is necessary to build trust with patients and their families, present successful cases after surgery, and promote enthusiasm and motivation among patients and their families so that patients undergo surgery under their best status.

3.1.2. Preoperative Care

Thyroid function, pituitary function, and field of vision were examined before the operation. Chloramphenicol was used to clear the nasal cavity 3 days before the operation to prevent postoperative infection. One day before the operation, the nose hairs were cut short, and the nostrils were cleaned with a cotton swab and salt water. Before the operation, the patients were instructed to breathe, urinate in bed, and eat in bed, so that the bowel pathways were unobstructed before surgery.

3.2. Routine Postoperative Care

3.2.1. Nasal Cavity Care

With the balloon catheter tamponade method, the patients were instructed not to pull the balloon catheter, and the family members were instructed to turn the patient over to prevent the tube from protruding. Using the iodine spinning

packing method, the patients were given a sterile treatment towel under the head. If the treatment towel was found to be contaminated, it was replaced in a timely manner. The two packing methods prevented fluid from dripping into the nasal cavity, the sputum was suctioned from the nasal cavity, and the gastric tube was indwelling to prevent intracranial infection caused by leakage or cerebrospinal fluid reflux. After the two packing materials were removed, if cerebrospinal fluid flowed out of the nasal cavity, the doctor was notified immediately.

3.2.2. Oral Care

After the operation, nasal cavity fluid flows into their mouth, which not only commonly causes bad breath and affects appetite but also results in bacteria accumunation, leading oral infection and poor wound healing. After surgery, the patients were forced to breathe through the mouth, which commonly causes chapped lips and increases the air humidity in the ward, so petroleum jelly was applied to the lips. Our department uses medical mouthwash for oral care twice a day, which can help to prevent oral infections and relieve symptoms of dry mouth.

3.2.3. Blood Glucose Monitoring and Care

Patients with growth hormone adenoma often have a high blood sugar. These patients followed the doctor's advice and orally consumed hypoglycemic drugs or received subcutaneous insulin injection. When the above methods fail to effectively control the blood sugar, insulin can be administered through an intravenous injection, and the amount of insulin and the frequency of blood sugar monitoring can be adjusted according to the fingertip blood sugar level. Moreover, nurses should educate the patients regarding diet and encourage family members and patients to actively cooperate. The long-term oral administration of glucocorticoids in patients with postoperative hypopituitarism is also the main cause of elevated blood glucose levels, and blood glucose levels should be closely monitored after discharge.

3.3. Observation and Nursing Care for Complications

3.3.1. Prevention and Care of Cerebrospinal Fluid Rhinorrhea

If a patient complained of clear watery fluid from the nasal cavity after surgery and the amount of fluid leakage increased when the head was lowered, cerebrospinal fluid rhinorrhea was suspected. Generally, conservative therapy was implemented first. In most cases, cerebrospinal fluid rhinorrhea healed within 1 to 2 weeks. If necessary, the lumbar cistern extra drainage was drained continuously. If the case of cerebrospinal fluid rhinorrhea did not heal itself after conservative treatment, surgical repair was performed.

3.3.2. Prevention and Care of Electrolyte Disorders

The doctor's instructions to conduct daily routine biochemical or electrolyte blood tests and dynamically observe the blood sodium and potassium levels were

strictly followed. The patients with hyponatremia and hypokalemia had clinical manifestations of dizziness, nausea, and fatigue, which can be rectified by intravenous or oral supplement.

3.3.3. Observation and Nursing Care for Headache

After the operation, the patients generally had headache symptoms due to the compression of the packing material and tissue edema. For patients with mild pain, the nurses instructed the patients to listen to music, find ways to distract their attention from the headache and pursue other methods to relieve the headache. For the patients who could not tolerate the headache, medications for pain relief were prescribed by a doctor.

3.4. Rehabilitation Advice and Follow-Up

The patients were encouraged to eat insipid food, refrain from drinking alcohol, avoid heavy physical labor and fatigue, and prevent colds, and falls. Blood tests regularly to monitor their hormone were recommended. A pituitary MR scan was taken 3 months after the operation, once every six months for 2 years, and once a year thereafter. The patients were instructed to avoid behaviors such as bowing their head, behaviors that induce constipation, and picking their nose for three months. The patients were encouraged to seek medical attention immediately if they had symptoms such as clear fluid leakage from the nasal cavity, nasal bleeding and fever.

4. Results

The two groups' data including patients were roughly identical with population characteristics and clinical features. The average age of the patients in the catheter balloon group was 50.29 ± 13.51 years old, including 11 males and 13 females. The average length of hospital stay was 14.88 ± 2.88 days, the average length of time from operation to discharge was 8.13 ± 1.75 days and the average length of packing retention time was 7.21 ± 3.34 days. The average age of the patients in the iodoform gauze group was 47.17 ± 9.91 years old, including 10 males and 14 females. The average length of hospital stay was 16.71 ± 5.04 days, the average length of time from operation to discharge was 9.54 ± 3.75 days and the average length of packing retention time was 7.67 ± 3.06 days. Severe postoperative complications were not unexpected observed in both groups. The success rate in the compression with catheter balloon group was 100% (24 of 24 patients); and in the iodoform gauze group 83.33% (20 of 24 patients). A catheter balloon was more successful in stopping bleeding at early stage than iodoform gauze. There were no statistically significant differences in the hospitalization stay time, operating day to discharge day and tampon indwelling time ($P > 0.05$) (Table 1). The incidence of CSF rhinorrhea was zero and electrolyte disturbance was 66.67% (16 of 24 patients) in the catheter balloon group. The incidence of cerebrospinal fluid rhinorrhea and electrolyte disturbance was 4.17% (1 of 24 patients) and 33.33% (8 of 24 patients) in the iodoform gauze group. The inci-

dence of complications did not significantly differ between the two groups of patients in terms of cerebrospinal fluid rhinorrhea and electrolyte imbalance ($P > 0.05$). The incidence of headache was 16.67% (4 of 24 patients) in catheter balloon group and 54.17% (13 of 24 patients) in iodoform gauze group. The incidence of postoperative headache in the balloon tamponade oppression group was statistically significantly lower than that in the tela iodoformum oppression group ($P < 0.05$) (Table 2).

5. Discussion

Pituitary tumor resection via sphenoid approach is a simple procedure with being minimally invasiveness, which yields a quick recovery, and has become the main choice of surgical treatment for pituitary tumors [11] [12] [13] [14]. Nasal packing is an indispensable step during surgery. The purpose of nasal cavity packing is to help reset the nasal mucosa and nasal septum, compress areas of bleeding, and prevent mucosal adhesions in the operation cavity. Therefore, it is critical that a suitable packing material is chosen, and nurses should provide high-quality intraoperative care for these patients, which plays a vital role during the recovery of patients.

For the traditional iodoform gauze packing material, due to the poor affinity of the material, the material needs to be folded layer by layer from the top of the nasal cavity to bottom, and the packing needs to have a certain depth and strength. These patients usually experienced severe pain after packing. Because the material is not easy to be controlled, it can also affect the patient's eating and breathing. To remove the iodoform gauze, the patient needs to undergo nasal endoscopy under local anesthesia in the operating room, and the nasal mucosa is prone to bleeding and adhesion after removal. For the catheter balloon compression hemostasis method, due to the plasticity of the balloon, the volume of water in the balloon can be adjusted according to the size of the patient's own nasal cavity, and the balloon and the nasal cavity fit well, thereby evenly compressing the hemostatic spot. The removal methods of the two materials are also obviously different: the former needs to be removed by nasal endoscopy under local anesthesia in the operating room; the latter only requires a simple operation at the bedside, that is the doctor uses a 10 ml sterile syringe to pull out the physiological saline in the balloon and then pulls it out gently.

Table 2. Comparison of the two groups of patients in terms of gender and other complications ($\overline{x} \pm s$).

Item		balloon tamponade oppression group	tela iodoformum oppression group	t	P
Gender	Male	11	10	0.085	0.771
	Female	13	14		
Cerebrospinal fluid rhinorrhea		0	1	1.021	0.312
Electrolyte disturbance		16	8	0.403	0.525
Headache		4	13	7.378	0.007

Postoperative headache is a common complication of pituitary tumor resection via sphenoid approach. Our results showed that the incidence of headache after nasal cavity surgery in the balloon tamponade oppression group was lower than that in the tela iodoformum oppression group, and the difference was statistically significant. Therefore, to improve patient comfort, the use of catheter balloon compression hemostasis is better than the use of the iodine spinning material. Although the success rate of packing material with the iodoform gauze did not demonstrate difference from that of packing with catheter balloon in stopping bleeding. the catheter balloon compression was apparently more preferable because none of the patients complained of obvious headache. While patients did complain of pain and discomfort immediately after spraying the nasal cavity in the iodoform gauze group, this demonstated that hemostasis with catheter balloon compression is suitable [15].

Simple transsphenoidal surgery for pituitary tumors has a relatively low risk of cerebrospinal fluid (CSF) leak. However, expanded endoscopic transnasal surgery (EETS) possesses a higher risk of CSF leak due to large dural defects and direct ventricular communication. In the literature, the rate of CSF leaks after transsphenoidal surgery ranges from 2% to 13% [16] [17] [18]. The risk of CSF leaks during the early stages of EETS was reported to be high, with a range of 5% - 50% reported in earlier series [19]-[25]. One case in our series (5%) underwent CSF leak repair in the iodoform gauze.

Several reconstruction techniques have been suggested, including the use of sphenoid sinus packing materials. However, no single type of packing material has proved to be superior to the others, though it is difficult to compare them because most studies have evaluated the techniques in a small number of cases with defects at different sites [26]. Some researcher reported the failure of primary sphenoid sinus packing and the need for secondary sphenoid sinus packing using endoscopic help [27].

Proper surgical sphenoid sinus packing materials based on anatomical understanding can reduce the risk of these complications. We compared CSF leak rates in balloon tamponade oppression group versus the tela iodoformum oppression group. We observed that in the tela iodoformum oppression group one case developed CSF leaks compared to 0 of 24 cases in balloon tamponade oppression group. In our series, although a multilayered reconstruction technique was used in all cases using a "gasket seal" rigid reconstruction technique and vascularized flaps, the postoperative leak incidence remained significantly earlier in the series. One main cause of this was sphenoid sinus packing materials. Retrospectively reviewing cases of CSF leak in the tela iodoformum oppression group, we noticed that use of tela iodoformum oppression could be one of the factors hindering healing of the reconstructed site. We gradually replaced tela iodoformum with balloon tamponade, which may have also contributed to the decrease in CSF leak rates later on.

Compared with the iodoform gauze packing material, urinary catheter balloon

compression hemostasis has the following advantages: 1) The catheter is easy to obtain and easy to use, and the indwelling time in the nasal cavity can be longer than that of the iodoform gauze. 2) The pressure of the urinary catheter balloon can be controlled by the water injection pressure, the compression effect is uniform, the hemostatic effect is reliable, and the headaches caused by traditional tamponade are less severe after tamponade. 3) Urinary catheters are soft and elastic, and the front end is trimmed, which is conducive to drainage, thus reducing the incidence of postoperative infection. 4) Compared with iodoform gauze, the urinary catheter balloon improves nasal ventilation in patients. 5) When a patient eats after the material is packed, the swallowing function will not be affected due to the action of the ventilation tube. 6) Before the catheter is removed, the saline in the body can be gradually removed for decompression observation to avoid rebleeding and perform secondary packing. 7) When the urinary catheter is removed, it is not easy to cause nasal mucosal adhesion, and the damage is small. In clinical nursing work, we need to pay attention to the following issues: a) If the water sac is ruptured, the patient may choke, and the doctor needs to deal with this issue in a timely manner [28] [29] [30]. b) After surgery, the patient's vital signs, state of consciousness, and urine color should be closely monitored, and the amount of fluid intake and output should be accurately recorded to reduce the incidence of complications. c) Patients should be educated well and instructed to avoid sneezing, coughing, and blowing their nose to prevent postoperative nose bleeding.

With regard to electrolyte disturbance, in the tela iodoformum oppression group, the incidence of electrolyte disturbance was 33.33% (8/24), 66.67% (16/24) in the balloon tamponade oppression group. Although there had difference in the incidence of electrolyte disturbance in the two groups, statistical significance did not be observed. We hypothesized that the main reason for electrolyte disturbance was sphenoid sinus packing materials inducing the pressure change. Of note, electrolyte imbalance was associated with injury of the pituitary stalk during surgery.

6. Limitations

Because the study is just limited to one department, the sample size is small. This study did not involve multiple research centers, the care by nurses in different hospitals will be different, and the possible effects will be different. In the following research, the model can be extended to multiple research centers and the sample size can be expanded, which would achieve better results.

7. Conclusion

The compression hemostasis method with a water balloon catheter is worthy of consideration in clinical practice. Nurses provide perioperative care for patients undergoing endoscopic pituitary tumor resection, and the occurrence of postoperative complications can be reduced by the close monitoring of changes in

patients' conditions. Patients should be provided with additional instructions to follow after discharge to determine the long-term effects of the operation and improve the prognoses and quality of life of patients.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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