Оригінальна стаття / *Original article*

Том 9, № 3–4 • 2024

PainMedicine Journal

Медицина Болю

www. painmedicine.org.ua

Міждисциплінарний • Науково-практичний журнал

DOI: 10.31636/pmjua.v9i3–4.3

Regional blockade in endoscopic surgical removal of pituitary adenoma

Akhmadov N. P., Nasibova E. M.

Azerbaijan Medical University, Baku, Azerbaijan

Abstract

Backround. *The endoscopic endonasal transsphenoidal approach is gaining popularity as an alternative to the traditional technique for removing pituitary adenomas using an operating microscope. In transnasal transsphenoidal resection of pituitary tumors, bilateral regional anesthesia of the pterygopalatine fossa, performed through subzygomatic access, has been found to be the most optimal technique.*

Methods. *To investigate the effectiveness of combining regional anesthesia with general anesthesia in reducing intraoperative drug administration and minimizing patient stress, two groups of patients were formed. Group I (n=14) received general anesthesia, while Group II (n = 23) underwent bilateral regional anesthesia of the pterygopalatine fossa in addition to general anesthesia, along with nasal mucosa application anesthesia.*

Results. *The results of the study indicate that the inclusion of regional blockade in the general anesthesia protocol is advisable for the removal of pituitary adenomas using the endoscopic transnasal transsphenoidal approach. This approach ensures hemodynamic stability and reduces the drug load during the operation.*

Conclusions. *In conclusion, the combination of regional anesthesia with general anesthesia ensures hemodynamic stability during both the intraoperative and postoperative periods.*

Key words: *pituitary adenoma, transnasal, transsphenoidal approach.*

Introduction

The endoscopic endonasal transsphenoidal approach to pituitary adenomas is gaining increasing popularity as an alternative to the traditional technique using an operating microscope. Although discussions are still ongoing about the superiority of the endoscopic approach over the microscopic approach in terms of completeness of resection, which is especially important for macroadenomas, endoscopic access offers advantages in assessing nasal function and degree of disability.

For the first time, the nasoethmoidal transsphenoidal approach to the sella turcica was performed by H. Schloffer in 1907, and H. Cushing established the transseptal transsphenoidal approach to the sella turcica as a standard technique in the surgical treatment of the chiasmal-sellar region. Transsphenoidal approach has limitations associated with the depth of the surgical field and the narrowness of the surgical wound, and therefore there is a risk of damage to the intracavernous part of the internal carotid artery, the walls and contents of the cavernous sinus, and the floor of the third ventricle.

For a more accurate visualization of the anatomical structures of this area, in 1958, Guiot first used fluoroscopy, and in 1963 reported the use of a rigid endoscope for transsphenoidal interventions on the pituitary gland. In 1965, G. Hardy developed and introduced into clinical practice an operating microscope, which, in combination with intraoperative fluoroscopy, made it possible to significantly reduce the incidence of complications and recurrence of tumors.

In 1977, M. Apuzzo et al. outlined the concept of intraoperative endoscopy for aneurysm clipping, discectomy, and transsphenoidal removal of pituitary adenomas. The authors emphasized the particular relevance of the use of endoscopy to achieve radical adenomectomy, which contributed to the renewed interest in transsphenoidal surgery of pituitary tumors with endoscopic support.

The treatment of patients with tumors of the chiasmatic-sellar region is considered a pressing issue in both neurosurgery and anesthesiology.

This is primarily due to the high prevalence of the disease (16% of all intracranial tumors), the location of tumors in the area surrounded by the most important anatomical formations (internal carotid arteries, cavernous sinus, chiasm, hypothalamus, third ventricle), and hormonal imbalance, which can accompany the development of the tumor and lead to severe somatic disorders. At the present stage of development of neurosurgery and the active introduction of the latest fiber optic and digital technologies into the field, a significant part of such tumors is removed using the endoscopic endonasal transsphenoidal approach, which, compared with other approaches, is characterized by a low complication rate (2–4%), low trauma, and high patient tolerance.

When using endoscopic access to the pituitary adenoma, the operation time is significantly reduced, which is especially important in patients with a large number of concomitant diseases, primarily cardiovascular, with the number of these steadily increasing worldwide. In addition, the reduced time of surgery decreases the risk of developing lung-related pathological changes associated with artificial ventilation. It should be noted that, the use of endoscopic access significantly improves the visualization of the surgical field and reduces the risk of blood loss, which is particularly important, especially for elderly and somatically burdened patients, in whom even a small blood loss of less than 800 ml can be accompanied by a significant violation of the oxygen transport function of the blood.

Taking into account all the above advantages of the endoscopic surgical approach to remove pituitary adenoma, this method is actively developing, and indications for its use are expanding, making it possible to operate on patients with clinically significant concomitant somatic pathology, especially in the cardiovascular system, as well as in geriatric patients. All this undoubtedly places high demands on anesthetic support, and the search for new sparing anesthesia techniques becomes a priority.

The choice of an anesthetic during the removal of a pituitary tumor by endoscopic transnasal transsphenoidal access, similar to other neurosurgical operations, primarily depends on its effect on the brain, such as reducing cerebral blood flow and metabolic demand, decreasing intracranial pressure or a minimal effect on it, and preserving regulatory mechanisms of cerebral blood flow. Additionally, the ideal anesthetic agent should have minimal impact on the cardiovascular system, avoid undesirable hemodynamic reactions, provide adequate pain relief, and enable early neurological evaluation.

Currently, anesthesiologists have access to a wide range of modern inhalation and non-inhalation anesthetics suitable for such procedures, each with its own advantages and disadvantages. However, it should be noted that there is no consensus on the preferred use of specific drugs. Therefore, there is a need to explore new anesthesia methods in this patient population to ensure adequate control and correction of perioperative hemodynamics and, if possible, reduce the overall drug load.

When performing transnasal transsphenoidal resection of a pituitary tumor, the most optimal approach, characterized by minimal complications and ease of use, is bilateral regional anesthesia of the pterygopalatine fossa, targeting the 2nd and partially 1st branches of the trigeminal nerve, performed through subzygomatic access. The combination of this regional blockade with general anesthesia improves anesthesia control, provides more stable hemodynamics (especially during the most traumatic stage of the operation — access to the

pituitary tumor), and reduces the negative impact on the cardiovascular system by minimizing the doses of anesthetics. This is particularly important for geriatric patients with severe cardiac pathology, as it promotes better management of anesthesia and reduces the associated risks.

Objective of the study

Optimization of anesthesia during endoscopic transnasal transsphenoidal removal of pituitary adenoma.

Material and research methods

The study included 37 patients who underwent endoscopic transnasal transsphenoidal surgery for pituitary adenoma at the surgical clinic of Azerbaijan Medical University. The surgical procedures were performed using a standard transsphenoidal approach with endoscopic support. The patients were positioned on the operating table with the head end raised by 30°, while the surgeon stood to the right of the patient at the chest level. A rigid endoscope and a Karl Storz endovideo camera (Germany) with a diameter of 4 mm, equipped with straight 0° and oblique 30° optics, were used for the transnasal endoscopic interventions on the pituitary gland.

All surgical procedures were conducted under general multicomponent anesthesia with tracheal intubation. In order to prove the effectiveness of the combination of regional anesthesia and general anesthesia and to reduce the intraoperative drug load and increase the patient's protection from stress, the patients were divided into two groups based on the method of anesthesia used. Group I (n = 14) received general anesthesia, while in Group II (n = 23), bilateral regional anesthesia of the pterygopalatine fossa and application anesthesia of the nasal mucosa were added to the general anesthesia protocol. Both groups were comparable in terms of age and gender.

In Group I, general anesthesia was induced with intravenous administration of propofol at an average dose of 2.67 ± 0.42 mg/kg and fentanyl at an average dose of 3.25 ± 0.41 μg/kg. Muscle relaxation was achieved with intravenous administration of rocuronium bromide at an average dose of 0.90 ± 0.12 mg/kg. After tracheal intubation, mechanical ventilation was performed using the Drager Fabius anesthetic-respiratory apparatus along a semi-open circuit, in in the Volume Control mode, with moderate hyperventilation and an end-tidal carbon dioxide (EtCO2) level of 34–36 mm Hg. Anesthesia was maintained with inhalation anesthetic sevoflurane at a concentration of 1.5–2.0 %.

In Group II, regional anesthesia was added to the general anesthesia protocol. After induction and tracheal intubation, a bilateral blockade of the second branch of the trigeminal nerve and the pterygopalatine ganglion was performed using the subzygomatic-pterygopalatine method with a 0.5 % bupivacaine solution. The method of blockade was as follows: the head of the patient turned in the opposite direction and for guidance, in the course of the implementation of this anaesthesia line was carried out (connecting the goat ear to the outer corner of the eye), which was further divided in half. The middle of this line corresponds to the middle of the zygomatic arch. At this point, the needle 22G was perpendicular to the skin through the half-moon cut of the vertical branch of the lower jaw pushed 4–5 cm deep until it reached the lateral pterygoid plate. The needle was then directed anteriorly and upward (at an approximate angle of 45° towards the eye). After that, the needle advanced in this direction past the lateral pterygoid plate for a distance of no more than 1.5 cm, minimizing its entry into the subarachnoid space. After confirming a negative aspiration test, 5 ml of 0.5 % bupivacaine solution was administered.

All patients included in the study underwent standard intraoperative monitoring using a Bionet 5 heart monitor, which encompassed ECG in standard lead II, pulse oximetry (SpO2), capnography (EtCO2), and body temperature monitoring. Hemodynamic parameters including blood pressure (BP), heart rate (HR), and mean arterial pressure (APmean) were evaluated at three key stages of the study:

- the beginning of the operation;
- at the most traumatic moment of the operation (access to the tumor);
- the end of the operation.

In addition to assessing hemodynamics in both groups, the consumption of medications used during the procedure was evaluated. Blood sugar levels were also measured as an indicator of intraoperative stress. Furthermore, to detect potential endocrine disorders, the levels of pituitary hormones such as cortisol, ACTH, free thyroxine, prolactin, TSH, and FSH were determined in all patients. Visual functions including visual acuity, fundus examination, and visual field assessment were performed before surgery and in the postoperative period.

Statistical analysis was conducted using both parametric and nonparametric statistical methods. The

chosen reliability criterion for significance was set at $p < 0.05$.

Results and discussion

The analysis of the obtained data revealed significant fluctuations in blood pressure and heart rate in patients of group I who received only general anesthesia throughout all major stages of the operation. Notably, at the most traumatic moment of the operation (access to the tumor), these patients experienced severe arterial hypertension and an increase in heart rate ($p < 0.05$), along with an elevation in mean arterial pressure (BP-mean) by 14.2 % compared to the initial stage. The heart rate also increased by 15.7 % during this stage.

Conversely, in patients of group II who received regional blockade in addition to general anesthesia, hemodynamic stability was observed without significant fluctuations in blood pressure and heart rate. Specifically, at the stage of access to the tumor, BPmean in this group showed a minimal change of 1.52 % compared to the initial data, and by the end of the operation, it slightly decreased by 3.9 % relative to the traumatic stage. Moreover, the heart rate in patients of this group increased by only 8.9 % at the traumatic stage and subsequently decreased by 4.9 % at the third stage relative to the second stage.

The analysis of drug consumption in both groups demonstrated notable differences. In the group without regional anesthesia, the consumption of propofol was 5.332±0.073 mg/kg/h, fentanyl was 2.175±0.054 mg/kg/h, and perlinganite was 0.26 ± 0.09 mg/kg. In contrast, the group that received regional anesthesia exhibited lower medication consumption. Specifically, the consumption of propofol in the regional anesthesia group was reduced by 5.97 % (4.87 % ± 0.01 mg/kg/h) compared to the group without regional anesthesia. The consumption of fentanyl was also lower by 15.9 % (1.765 ± 0.072 mg/kg/h) in the regional anesthesia group compared to the group without regional anesthesia. As for perlinganitis, its consumption in the regional anesthesia group was 0.04 ± 0.0025 mg/kg/h.

When comparing hemodynamic parameters and medications in both groups, it was found that the group utilizing regional blockade as a component of anesthesia exhibited significantly more stable hemodynamics ($p < 0.05$) during the traumatic stage of the operation (access to the tumor). Moreover, this group demonstrated a statistically significant reduction in medication consumption ($p < 0.05$).

To assess the adequacy of anesthesia and the body's response to pain, blood sugar levels were measured as a marker of intraoperative stress. Blood glucose content was studied at three stages of the operation: the beginning of the operation, access to the tumor, and the end of the operation. In group I, where only general anesthesia was used, the blood glucose levels at these stages were as follows: 4.8 ± 1.7 mmol/l, 5.25 ± 0.14 mmol/l, and 6.25 ± 0.15 mmol/l, respectively. By the end of the operation, the blood glucose level in the group without regional anesthesia significantly increased ($p < 0.05$) by 23.5 % from the initial data and was 18.7 % higher ($p < 0.05$) compared to the group with regional anesthesia.

In contrast, the group of patients with regional anesthesia exhibited blood glucose levels of 5.03 ± 0.15 mmol/l, 4.98 ± 0.08 mmol/l, and 5.17 ± 0.15 mmol/l at the respective stages of the operation. A comparative study of the glucose levels revealed minimal significant changes. The increase in glucose concentration from the beginning to the traumatic stage of the operation in this group was only 3.1 %, which was not significant. These findings suggest a weakened stress response to pain.

Furthermore, the group of patients who received intraoperative bilateral regional anesthesia in the pterygopalatine fossa experienced a decrease in pain syndrome, particularly in the first 6–8 hours postoperatively. Additionally, there was a reduced consumption of analgesics in this group.

Conclusions

In conclusion, the combination of regional anesthesia with general anesthesia ensures hemodynamic stability during both the intraoperative and postoperative periods. The results of this study support the inclusion of regional blockade in the protocol of general anesthesia for the removal of pituitary adenoma using an endoscopic transnasal transsphenoidal approach. This approach helps maintain hemodynamic stability and reduces the overall drug load during the operation.

Funding

The study did not receive any sponsorship.

Conflict of Interest

The authors declare no conflict of interest.

References

1. Upadhyay S, Buohliqah L, Dolci RLL, Otto BA, Prevedello DM, Carrau RL. Periodic olfactory assessment in patients undergoing skull base surgery with preservation of the olfactory strip. The Laryngoscope [Internet]. 2017 Mar 27;127(9):1970–5. Available from: http://dx.doi.org/10.1002/lary.26546.
2. Lin LY, Teng MMH, Huang CI, Ma WY, Wang KL, Lin HD, et al. Assessment of Bilateral Inferior Petrosal Sinus Sampling (BIPSS) in the Diagnosis of Cushing's Disease. Journal of the Chinese Medical Association [Internet]. 2007 Jan;70(1):4–10. Available from: http://dx.doi.org/10.1016/s1726-4901(09)70293-x.
3. Sasagawa Y, Tachibana O, Doai M, Hayashi Y, Tonami H, Iizuka H, et al. Carotid artery protrusion and dehiscence in patients with acromegaly. Pituitary [Internet]. 2016 May 20;19(5):482–7. Available from: http://dx.doi.org/10.1007/s11102-016-0728-z.
4. Sahyouni R, Goshtasbi K, Choi E, Mahboubi H, Le R, Khahera AS, et al. Vision Outcomes in Early versus Late Surgical Intervention of Pituitary Apoplexy: Meta-Analysis. World Neurosurgery [Internet]. 2019 Jul;127:52–7. Available from: http://dx.doi.org/10.1016/j.wneu.2019.03.133.
5. Berker M, Hazer DB, Yücel T, Gürlek A, Cila A, Aldur M, et al. Complications of endoscopic surgery of the pituitary adenomas: analysis of 570 patients and review of the literature. Pituitary [Internet]. 2011 Dec 8;15(3):288–300. Available from: http://dx.doi.org/10.1007/s11102-011-0368-2.
6. Briceno V, Zaidi HA, Doucette JA, Onomichi KB, Alreshidi A, Mekary RA, et al. Efficacy of transsphenoidal surgery in achieving biochemical cure of growth hormone-secreting pituitary adenomas among patients with cavernous sinus invasion: a systematic review and meta-analysis. Neurological Research [Internet]. 2017 Mar 16;39(5):387–98. Available from: http://dx.doi.org/10.1080/01616412.2017.1296653.
7. Timperley D, Sacks R, Parkinson RJ, Harvey RJ. Perioperative and Intraoperative Maneuvers to Optimize Surgical Outcomes in Skull Base Surgery. Otolaryngologic Clinics of North America [Internet]. 2010 Aug;43(4):699–730. Available from: http://dx.doi.org/10.1016/j.otc.2010.04.002.
8. Wormald PJ, van Renen G, Perks J, Jones JA, Langton-Hewer CD. The effect of the total intravenous anesthesia compared with inhalational anesthesia on the surgical field during endoscopic sinus surgery. Am J Rhinol [Internet]. 2005 Sep-Oct;19(5):514-20. Available from: https://pubmed.ncbi.nlm.nih.gov/16270608/.
9. Lu VM, Phan K, Oh LJ. Total intravenous versus inhalational anesthesia in endoscopic sinus surgery: A meta-analysis. The Laryngoscope [Internet]. 2019 May 3;130(3):575–83. Available from: http://dx.doi.org/10.1002/lary.28046.
10. Danielsen A, Gravningsbråten R., Olofsson J. Anaesthesia in endoscopic sinus surgery. European Archives of Oto-Rhino-Laryngology [Internet]. 2003 Oct 1;260(9):481–6. Available from: http://dx.doi.org/10.1007/s00405-003-0613-z.
11. Roxbury CR, Lobo BC, Kshettry VR, D'Anza B, Woodard TD, Recinos PF, et al. Perioperative management in endoscopic endonasal skull-base surgery: a survey of the North American Skull Base Society. International Forum of Allergy & Rhinology [Internet]. 2017 Dec 20;8(5):631–40. Available from: http://dx.doi.org/10.1002/alr.22066.
12. Orlandi RR, Lanza DC. Is Nasal Packing Necessary Following Endoscopic Sinus Surgery? The Laryngoscope [Internet]. 2004 Sep;114(9):1541–4. Available from: http://dx.doi.org/10.1097/00005537-200409000-00007.
13. Svider PF, Nguyen B, Yuhan B, Zuliani G, Eloy JA, Folbe AJ. Perioperative analgesia for patients undergoing endoscopic sinus surgery: an evidence-based review. International Forum of Allergy & Rhinology [Internet]. 2018 Apr 12;8(7):837–49. Available from: http://dx.doi.org/10.1002/alr.22107.

Регіонарна блокада при ендоскопічному хірургічному видаленні аденоми гіпофіза

Ахмадов Н. П., Насібова Є. М.

Азербайджанський медичний університет, Баку, Азербайджан

Анотація. Актуальність. *Ендоскопічний ендоназальний транссфеноїдальний доступ набуває популярності як альтернатива традиційній техніці видалення аденоми гіпофіза з використанням операційного мікроскопа. При трансназальній транссфеноїдальній резекції пухлин гіпофіза найоптимальнішою технікою визнано двосторонню регіонарну анестезію крило-піднебінної ямки, яка виконується через підвиличний доступ.*

Методи. *Для дослідження ефективності поєднання регіонарної анестезії із загальною анестезією для зменшення інтраопераційного введення лікарських засобів та мінімізації стресу пацієнта було сформовано дві групи пацієнтів. І групі (n = 14) проводили загальну анестезію, а ІІ групі (n = 23) крім загальної анестезії разом із аплікаційною анестезією слизової оболонки носа проводили двосторонню регіонарну анестезію крило-піднебінної ямки.*

Результати. *Результати дослідження свідчать про доцільність включення регіонарної блокади в протокол загальної анестезії при видаленні аденоми гіпофіза ендоскопічним трансназальним транссфеноїдальним доступом. Такий підхід забезпечує стабільність гемодинаміки та знижує медикаментозне навантаження під час операції.*

Висновки. *Таким чином, поєднання регіонарної анестезії з загальною анестезією забезпечує стабільність гемодинаміки як в інтраопераційному, так і в післяопераційному періодах.*

Ключові слова: *аденома гіпофіза, трансназальний, транссфеноїдальний доступ.*