ORIGINAL ARTICLE

OPTIMIZATION OF LOCAL ANESTHESIA OF DENTAL PATIENTS DURING CYSTECTOMIES OF RADICULAR CYSTS THAT HAVE GROWN INTO THE MAXILLARY SINUS OR NASAL CAVITY

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ABSTRACT

The aim: To provide clinical evaluation of the effectiveness of anesthesia for cystectomy of radicular cysts that have grown into the maxillary si-nus or nasal cavity using different techniques of endonasal block-ade of the nasopalatine nerve.

Materials and methods: Clinical observations were conducted on 52 patients of different age and sex. These patients were diagnosed with large radicular cysts (more than 3.0 cm in diameter) that had grown into the maxillary sinus (33 cases) or into the nasal cavity (19 cases). The surgical excisions of cysts (oroantral cystectomies) were performed un-der local potentiated anesthesia. Patients were divided into two clinical groups, depending on the methods used for endonasal blockade of the nasopalatine nerve: the main and the control group. Patients in the main group underwent endonasal blockade of the nasopalatine nerve at the point of its emergence from the pterygopalatine ganglion. In the control group, the neural blockade was performed at the entry of this nerve into the incisive canal.

Pain sensitivity and perception in patients were studied using subjective and objective methods. The data was analyzed by means of the Pearson's chi – square tests.

Results: During the enucleation of radicular cysts that grew into the inferior nasal meatus and maxillary sinus in patients of the main group there was no pain observed. There were no manifestations of pain-induced stress neither from the side of autonomic system, nor physical or emotional manifestations of pain, which confirmed the effectiveness of nasopalatine nerve anesthesia. In patients of the control group during similar operation the full effect of local anesthesia was achieved in 56.0% of cases ($\chi 2 - 9{,}270$, $p = 0{,}003$). The rest of the patients during cystectomies showed some signs of pain-induced stress from the side of autonomic system or in the form of physical or emotional manifestations.

Conclusions: Endonasal blockade of the nasopalatine nerve at the point of its emergence from the pterygopalatine ganglion invariably provided a complete analgesia during enucleation of radicular cysts that have grown into the maxillary sinus or nasal cavity. Anesthesia of the nasopalatine nerve at its entry into the incisive canal allows pain-less cystectomy of radicular cysts that have spread to the front of the inferior nasal meatus from the front teeth.

KEY WORDS: radicular cyst, cystectomy, maxillary sinus, nasal cavity, nasopala-tine nerve, local anesthesia, pain-induced stress

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INTRODUCTION

Dental surgeries may cause pain and lead to pain-induced stress reactions [1 – 3]. Among the factors that determine their development are psycho-emotional tension (fear, anxiety, phobias), pain, pathological reflexes and other factors [4 – 8]. High-quality anesthesiological support allows to provide anti-stress protection of surgical patients. Conductive anesthesia of peripheral branches of the trigeminal nerve (trigeminal nerve block) is most commonly used for anesthesia of the tooth – alveolar complex according to standard methods [1, 2, 6, 9, 10]. Surgical interventions on the maxillary sinus in the treatment of chronic odontogenic sinusitis and during cystectomies of odontogenic cysts that have grown into the maxillary sinus can be performed either under general anesthesia [11 -13] or under local potentiated anesthesia [14, 15]. In the latter case, a desirable analgesic effect is achieved by a combination of premedication (analgesia) and local anesthesia of the sub-orbital and great palatine nerves, the upper posterior alveolar branches of the maxillary nerve. In addition, when performing surgical manipulations in the nasal cavity – endoscopy of the maxillary sinus, enucleation of the odontogenic cysts that have grown into the inferior nasal meatus, it is also necessary to block the nasopalatine nerve during anesthesia of the operation site [16 – 19]. According to some authors [20], the most optimal is the nerve block injection of the pterygopalatine ganglion (ganglion pterygopalatinus), approaching through the greater palatine canal (canalis palatinus major). We believe that this method of the pterygopalatine ganglion blockade is not always easy to perform due to the anatomical variability of the greater palatine canal [21 – 23], in-stead it is possible to use in such cases endonasal methods of an-esthesia of the nasopalatine nerve at the point of its emergence from the pterygopalatine ganglion or at its entry into the incisive canal.

Table I. The Sounds, Eyes, and Motor (SEM) scale for measuring the comfort or discomfort

Observations	Comfort	Discomfort		
		Mild pain	Moderate pain	Severe pain
Sounds	No sounds indicating pain	Nonspecific sounds; possible pain indication	Specific verbal complaints, e.g., "Ouch", raises Voice	Verbal complaint indicates intense pain, e.g., scream, sobbing
Eyes	No eye signs indicating discomfort	Eyes wide, show of concern, no tears	Watery eyes, eyes flinching	Crying, tears running down face
Motor	Hands relaxed; no apparent body tension	Hands show some distress or tension, grasps chair due to discomfort, muscular tension	Random movement of arms or body without aggressive intention of physical contact, grimace, twitch	Movement of hands to make aggressive physical contact, pulling head away

THE AIM

To provide clinical evaluation of the effectiveness of anesthesia for cystectomies of radicular cysts that have grown into the maxillary sinus or nasal cavity using different techniques of endonasal blockade of the nasopalatine nerve.

MATERIALS AND METHODS

Clinical observations were conducted on 52 patients of different ages (from 20 to 65) and sex (34 males and 18 females). These were the patients who received treatment at the department of surgical dentistry and maxillofacial surgery. All of them were diagnosed with radicular cysts of large size (> 3.0 cm), which penetrated the maxillary sinus (33 cases) or the nasal cavity – 19 cases. Cystectomies (oroantral cystectomy) were performed under local potentiated anesthesia. All patients received pre-operational premedication (intramuscular): 2% solution of promedol (trimeperidine) – 1 ml, 0.5% solution of sibazone (diazepam) – 2.0 ml, 1% solution of diphenhydramine (diphenhydramine hydrochloride) – 1, 0 ml, 0.1% solution of atropine – 1.0 ml. For conducting of local an-esthesia (infraorbital, palatal, tuberal) we used "Ultracain® D-S forte" (articaine hydrochloride and epinephrine solution, 1:100000 dilution).

The patients were divided into two clinical groups, depending on the methods used for endonasal blockade of the nasopalatine nerve: the main and the control group. The patients in the main group (27 people) had a blockade of the nasopalatine nerve by application anesthesia of the nasal mucosa near the posterior edge of the middle nasal meatus, at the point of the nasopalatine nerve emergence from the pterygopalatine ganglion [24]. To do this, a nasal probe with a sterile cotton swab soaked in 10% solution of lidocaine with adrenaline in 1: 100 000 dilution, was inserted into the dorsum of the nasal cavity and at an angle of 25 ° – 30 ° to the hard palate was advanced in the middle nasal passage to a depth of 4.5 – 5, 0 cm. Our choice of such technical parameters was based on the findings of morphometric studies obtained by the authors [25].

In 25 patients of the control group, standard intranasal blockade of the nasopalatine nerve was performed by application anesthesia with 10% lidocaine solution with adrenaline of the mucous membrane at the base of the nasal septum, in the funnel-shaped area where this nerve enters the incisive canal [26].

Pain sensitivity and perception in patients were studied using subjective and objective methods. Pain sensitivity was determined by injection of a needle (pinprick) into the mucous membrane. The assessment of pain sensitivity was performed on a four-point scale in each quadrant: 0 points – no sensitivity, 1 point – sensitivity is sharply reduced, 2 points – sensitivity is moderately reduced, 3 points – tactile and pain sensitivity is completely preserved [27]. Pain perception during local anesthesia administration was evaluated by the Sounds, Eyes and Motor (SEM) scale [28]. SEM scale was used to assess the observed pain. It is divided into two categories of comfort and discomfort. The discomfort response is further divided into three subscales: mild pain, moderate pain and severe pain (Table I).

Autonomic reaction of the cardiovascular system to pain was evaluated by the perfusion index (PI) monitored with the pulse oximeter Elera SH-K3 (Hong Kong). The normal PI range is 5–6 %. It de-creases with the narrowing of the lumen of the peripheral blood vessels caused by the pain triggers [29].

The protocol used in this study conformed to the tenets of the Declaration of Helsinki and was approved by the Ethics Committee of the Danylo Halytsky Lviv National Medical University and of the Ukrainian Medical Stomatological Academy.

The reliability of the obtained results was evaluated according to the reliability criterion of the Student by statistically computing the data using the commonly used methods of variation statistics from the package «Statistica-8». The data was analyzed by means of the Pearson's chi–square tests.

RESULTS

During the enucleation of the radicular cysts that have penetrated the inferior nasal meatus, all patients in the main group had no pain. According to the prick-test, all of them revealed a complete loss of pain sensitivity (0 points) of the mucous membrane of the inferior nasal meatus in the area of localization of radicular cysts, which confirmed the effectiveness of the applied method of anesthesia of the nasopalatine nerve. While in the group, where we per-formed the blockade of peripheral branches of the maxillary nerve (suborbital, greater palatine, nasopalatine nerves, upper posterior alveolar branches) the outcome was different. In

Table II. The clinical effectiveness of used intranasal methods of anesthesia of the nasopalatine nerve

Operation site of cystectomy of radicular cyst	Method of anesthesia of the nasopalatine nerve near the incisive canal (n = 25)		Method of anesthesia of the nasopalatine nerve near the ganglion pterygopalatinus (n = 27)		Pearson's coefficient χ2 (p)
	Total anesthesia in the operating area	Partial anesthesia in the operating area	Total anesthesia in the operating area	Partial anesthesia in the operating area	
Cystectomy in the maxillary sinus	9 cases	7 cases	15 cases	2 cases	4,251 (p = 0,040)
Cystectomy in the nasal cavity	5 cases	4 cases	10 cases	no cases	5,630 (p = 0,018)
Totally n - cases (%)	14 cases (56,0 %)	11 cases (44,0 %)	25 cases (92,6 %)	2 cases (7,4 %)	9,270 (p = 0,003)

15 cases we also managed to painlessly perform oroantral cystectomy and removed pathologically altered (hyperplastic) mucosa, pathological granulations. However, 2 patients of this clinical group at the stage of formation and mobilization of the buccal muco-periosteal flap for plastic closure of oroantral communications, formed in the sockets of the removed third upper molars, demonstrated emotional/motor (mild pain – beyond the SEM scale) and autonomic (index RI – 3.5 – 4.0%) manifestations of the pain-induced stress. The prick test revealed moderate pain sensitivity (2 points) of the mucous mem-brane in the distal (buccal) part of the mucoperiosteal flap, which is associated with possible participation of the buccal nerve in the sensitive innervation of this anatomical area of the oral cavity [30]. After additional infiltration anesthesia, we finally achieved a complete loss of pain sensitivity in this area.

The patients of the control group during cystectomy of radicular cysts that have penetrated the nasal cavity experienced and demonstrated pain more often than the patients of the main group (χ^2 – 5,630,p = 0.018), which was associated with insufficient effectiveness of local anesthesia of the surgical site. In particular, 4 patients retained pain sensitivity during enucleation of odontogenic cyst, which spread from the periapical areas of the "causal" premolars to the maxillary sinus and the distal direction of the lower nasal passage.

The pain sensitivity in the mucous membrane of the bottom of the nasal cavity was evaluated in 2.7 ± 0.4 points. On the doctor's at-tempt to begin the surgery, such patients manifested motor (dis-comfort according to SEM scale) and autonomic (PI = 2.9 ± 0.6%) reactions to pain triggers. After additional infiltration anesthesia the total loss of sensitivity was reached. It should be noted that in 5 patients whose radicular cysts were located at the level of the roots of the front teeth of the upper jaw and grew into the frontal part of the nasal cavity, cystectomy operations were painless.

During oroantral cystectomy, pain occurred in 6 patients at the stage of removal of pathologically altered mucous tissue on the medial (nasal) septum of the maxillary sinuses. Its distal part, at the level of the middle nasal meatus, turned out to be especially "sensitive". This testified to the ineffectiveness in such cases of the classical intranasal technique of incisal anesthesia. In one case, we observed insufficient local anesthesia in the area of the bone defect of the third molar socket during its plastic closure with a mucoperiosteal flap. All the above-mentioned patients experienced emotional discomfort due to pain, there was a decrease in the per-fusion index. Intergroup differences in the effectiveness of anesthesia support for cystectomy operations performed in the maxillary sinuses were statistically significant – χ^2 – 4,251, p = 0,040 (Table II).

DISCUSSION

On the background of application anesthesia of the nasal mucosa, which is innervated by the nasopalatine nerve [31], diagnostic and therapeutic procedures are performed – endoscopy of the paranasal sinuses, tamponade of the nasal cavity [32, 33]. Electroneurophysiological studies have shown that in the innervation of the pulp of the incisors of the maxilla in addition to the anterior alveolar branches of the infraorbital nerve, nasopalatine nerve may also be involved. When it is blocked in the lower nasal passage before entering the incisal canal, the effect of anesthesia of the pulp of these teeth is potentiated [34]. To increase the effectiveness of analgesia in this group of teeth, it is advisable to inject a local anesthetic in the middle nasal passage [35].

After inserting a cotton applicator impregnated with anesthetic into the middle nasal passage and its advance to the posterior edge of the middle nasal cavity, it is possible to reach the place where pterygopalatinum ganglion (PPG) is located. Its post-synaptic fibers innervate the lacrimal and nasal glands. This autonomic node is involved in the pathogenesis (regulation of vascular response) in various pain syndromes: headache (migraine), trigeminal neuralgia, facial pain induced by herpes virus infection. Clinical studies have shown that these pain disorders can be effectively managed with endonasal blockade of PPG [36 – 39]. In maxillofacial surgery, PPG regional anesthesia is performed mainly by injection, by inserting a needle into the pterygopalatine fossa by extrazygomatic [40, 41], subtemporal [42], palatal [43, 44] accesses.

However, during using of these techniques of conductive anesthesia PPG there is a risk of blood vessels and nerves damage by the injection needle during its advancement , it may break. With excessive administration of a local anesthetic, it can spread through the lower orbital fissure into the orbit and cause diplopia [45 – 48]. Therefore, in our opinion, the safest (the least traumatic) and available for technical performance, free of possible local complications is the endonasal method of PPG blockade, which also blocks the nasopalatine nerve.

CONCLUSIONS

Endonasal blockade of the nasopalatine nerve at the point of its emergence from the pterygopalatine ganglion invariably provides a complete analgesia during enucleation of radicular cysts that have penetrated the maxillary sinus or nasal cavity. An-esthesia of the nasopalatine nerve at its entry into the incisive canal allows painless cystectomy of radicular cysts that have spread to the front of the inferior nasal meatus from the front teeth.

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