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Assessment the Impact of the Torus Tubarius Correction by Power-Assisted Technique on the Equipressor Eustachian Tube Function

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Purpose of the research is to evaluate the impact of the torus tubarius correction by microdebrider technique on the eustachian tube function in children without middle ear pathology.

Materials and methods. 115 children aged 3 to 12 years participated in the study. All children underwent endoscopic modified microdebridement adenotomy for the first time, which, in the case of tubal hypertrophy (we analyzed the frequency of this phenomenon), was combined with its correction by the microdebridement method. For the next stage of the research, we selected 19 children, who had preoperative intratympanic pressure monitoring results more than —100 daPa and who hadn't concomitant tonsil hypertrophy (19 children). Control measurement was done on days 1 and 8–10 after the intervention. Depending on the presence/absence of concomitant hypertrophy of the torus tubarius, patients were divided into the main (11 patients) and control (8 patients) groups. The analysis was carried out using the STATISTICA program.

Results. 36 patients were diagnosed with torus tubarius hypertrophy. When comparing intratympanic pressure on the 1st day after the intervention in patients of the main and control groups, a significant difference in values was found (-144.37±41.09/-95.00±27.90 daPa). On day 8–10, the intratympanic pressure data in patients of both groups did not differ from each other (-39.15±14.85 daPa in the main and -33.87±19.57 daPa in the control groups) and preoperative values in both groups.

Conclusions. Hypertrophy of the torus tubarius is noted in 31.3% of patients with primary adenotomy. The microdebrider technique method of torus tubarius correction is safe in view of the equipressor function of the auditory tube.

The research was carried out in accordance with the principles of the Declaration of Helsinki. The research protocol was approved by the Local Ethics Committee of the institution mentioned in the work. Informed consent of parents or their guardians was obtained for conducting research.

No conflict of interests was declared by the authors.

Keywords: children, torus tubarius, adenoidectomy, upper respiratory tract, pharyngeal tonsil hypertrophy, adenoid vegetations, microdebridger, tympanometry, endoscopic rhinosurgery.

Оцінка впливу корекції трубного валика мікродебридерним методом на еквіпресорну функцію слухової труби

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Метою — оцінити вплив корекції гіпертрофії трубного валика мікродебридерним методом на еквіпресорну функцію слухової труби.

Матеріали та методи. До дослідження залучено 115 дітей віком від 3 до 12 років. Усім дітям уперше виконано ендоскопічну модифіковану мікродебридерну аденотомію, яка за наявності гіпертрофії трубного валика поєднувалася з його корекцією мікродебридерним способом. Для наступного етапу дослідження відібрано 19 дітей, у яких передопераційний моніторинг внутрішньобарабанного тиску перевищував —100 даПа та хто не мав супутньої гіпертрофії мигдаликів (19 дітей). Контрольне вимірювання проведено на 1 та 8–10-ту добу після втручання. Залежно від наявності/відсутності супутньої гіпертрофії torus tubarius хворих поділено на основну (11 хворих) і контрольну (8 хворих) групи. Статистичну обробку даних виконано за допомогою програми «STATISTICA».

Результати. У 36 осіб виявлено гіпертрофію трубних валиків. За порівняння інтратимпанального тиску на 1-шу добу після втручання в пацієнтів основної та контрольної груп виявлено достовірну різницю значень (-144,37±41,09/-95,00±27,90 даПа; $p<0,05$). На 8-10-ту добу дані інтратимпанального тиску в пацієнтів обох груп не різнилися між собою (-39,15±14,85 даПа в основній та -33,87±19,57 даПа в контрольній групах) і доопераційними показниками в обох групах.

Висновки. Гіпертрофія трубних валиків відмічається у 31,3% пацієнтів за первинної аденотомії. Мікродебридерний спосіб корекції трубних валиків є безпечним з огляду на еквіпресорну функцію слухової труби.

Дослідження виконано відповідно до принципів Гельсінської декларації. Протокол дослідження ухвалено Локальним етичним комітетом зазначеної в роботі установи. На проведення досліджень отримано інформовану згоду батьків.

Автори заявляють про відсутність конфлікту інтересів.

Ключові слова: діти, трубний валик, аденотомія, верхні дихальні шляхи, гіпертрофія глоткового мигдалика, аденоїдні вегетації, мікродебридер, тимпанометрія, ендоскопічна ринохірургія.

Among the structures of the Walderyer's ring, which are located in the nasopharynx, the pharyngeal tonsil is the most frequent subject of study in pediatric otolaryngology. Other structures of the ring, namely the tubal tonsils, are often disregarded by doctors due to their localization [6]. The anatomical description of the pharyngeal tonsil was recorded much earlier by Schneider (1661) (Ruben, 2017), in comparison with the description of the accumulation of lymphoid tissue around the pharyngeal ostium of the eustachian tube (tubal tonsil) — Rüdinger (1872) and Gerlach (1875), and the accumulation of lymphoid tissue in the pharyngeal recess were described by Eggstone and Wolff only in 1947 [3]. Back in 1954, U. Aschan distinguished between them, noting that the lymphoid tissue of the pharyngeal recess can never extend to the ostium of the eustachian tube [3]. However, today the authors stick to different points of view on the relationship between these lymphoid formations, describing them both as one tonsil with the spread of the tubal tonsil to the torus tubarius [1,10,15,21] and as separate formations [23].

The tubal tonsil and the lymphoid tissue of the torus tubarius (LTTT) in recent decades is increasingly becoming the focus of studies and the point of influence in middle ear pathology [7,9,24]. The widespread introduction of new safe methods of surgical intervention, such as shaver, radiowave, electrothermadhesion, coblation, laser technologies [14,16,17,21,23] performed under endoscopic control will allow effective and safe correction of LTTT and tubal tonsil.

Changes in torus tubarius and LTTT can also lead to the development of symptoms unrelated to middle ear diseases, such as snoring and apnea [12,23], mimicking the symptoms of adenoid vegetations when adenoidectomy is ineffective [12]. In addition, LTTT can be the location of biofilms that spread from the pharyngeal tonsil and act as a reservoir of infection in the pathogenesis of recurrent inflammatory diseases of the upper respiratory tract in children [13].

The literature presents a significant number of studies that prove the precision, accuracy and tissue preservation of the microdebrider adenoidectomy [11,18], which has transient [5] and less pronounced effect on the Eustachian tube function compared to the traditional method [4]. However, since the correction was most often performed in patients with middle ear pathology (including the Eustachian tube), no data on the direct effect of the method on a normally functioning Eustachian tube was found.

The ***purpose*** of the study — to assess the impact of the torus tubarius correction by microdebrider technique on the equipressor Eustachian tube function in children without middle ear pathology.

Materials and methods of the research

The study involved 115 children (74 boys and 41 girls) aged 3–12 years, who were treated for adenoid vegetations at children's hospital of the State Scientific Institution 'Scientific and Practical Center of Preventive and Clinical Medicine' of the State Administration. The study was conducted as part of the research work of the Department of Pediatric Otorhinolaryngology of the Shupyk National Healthcare University of Ukraine and the research work of the Department of Minimally Invasive Surgery of the State Scientific Institution 'Scientific and Practical Center of Preventive and Clinical Medicine' of the State Administration. The study was conducted in accordance with the principles of the Helsinki Declaration. Ethical approval No.15 of 21.12.2020 from the Ethics Commission of the Shupyk National Healthcare University of Ukraine was obtained to carry out the research. Informed consent for the research was obtained from the parents.

All patients underwent endoscopic power-assisted adenoidectomy. The method involved removing the main mass of the pharyngeal tonsil in the lower and middle part with a Beckmann's adenotome (biopsy sample collection) followed by accurate removal of lymphoid tissue in the perichoanal and peritubal regions using a microdebrider. During the intervention, the condition of the torus tubarius was assessed. Its size and shape (uniform thickness, local thickening, presence of additional particles) and the prolapse of lymphoid tissue into the choanae were taken into account.

In case of the torus tubarius hypertrophy (TTH) after adenoidectomy, its correction was performed with tangential movements to the surface of the torus tubarius to obtain a uniform thickness of the tissue above the cartilage, without reaching the level of the perichondrium. Correction was performed on the front part of the medial surface of the torus tubarius without resection in the depth of the Rosenmüller fossa to avoid further contact of the wound surfaces (torus tubarius and peritubal region of the pharyngeal tonsil). A 60° microdebrider tip with the working window rotated towards the intervention was used for this purpose.

Table 1

Distribution of patients into groups by age and gender

Characteristics	Main group, (n=11), M±m	Control group, (n=8), M±m	P
Mean age, years	5.63±2.69	6.37±3.62	>0.05[1]
Gender, male/female	5/6	4/4	>0.05[2]

Notes: 1 — according to the Mann—Whitney test; 2 — according to the Fisher's test.

After primary hemostasis, point coagulation of bleeding sites was performed over the entire surface of the nasopharynx.

For the second phase of the study, patients were selected according to the criteria outlined below.

Inclusion criteria was the presence of indications for adenoidectomy: nasal breathing disorder, snoring, apnea, chronic nasopharyngitis, as well as combination of hypertrophy of the pharyngeal tonsil with accompanying pathology, such as recurrent acute and chronic rhinosinusitis in the anamnesis. *Exclusion criteria* were the presence of concomitant pathology of the maxillofacial area, injuries or operative interventions of the maxillofacial area in past medical history, the presence of concomitant secretory otitis media, vasomotor rhinitis, recurrent acute otitis media and previous interventions on the pharyngeal lymphoid ring in the anamnesis, presence of eustachian tube dysfunction (pressure in the tympanic cavity 100 daPa and less [20]), including unilateral, hypertrophy of the palatine tonsils and refusal to undergo a control tympanometry.

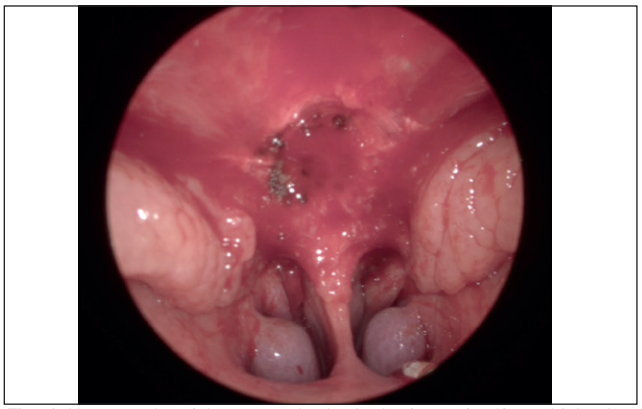

Fig. 1. Hypertrophy of the torus tubarius in the form of uniform thickening. Intraoperative view of the nasopharynx after removal of the pharyngeal tonsil

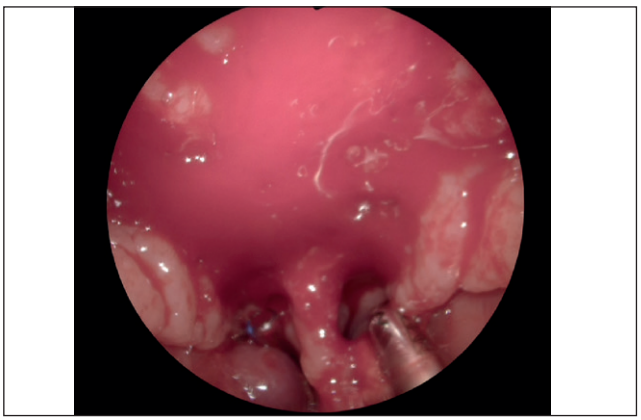

Fig. 2. Hypertrophy of the torus tubarius on both sides in the form of an additional lobe. Intraoperative view of the nasopharynx after removal of the pharyngeal tonsil

As a result, 19 children took part in the second phase of the study. These patients were assigned to the main group — 11 children (with TTH), and 8 remaining children — to the control group (Table 1). The distribution of patients into groups by age and gender did not differ in the presented groups.

Impedancemetry (tympanometry) was used to assess the invasiveness of the performed intervention in relation to the tissues of the peritubal regions of the nasopharynx and the torus tubarius. It is well known that the results obtained with the help of this research method correlate with the severity of nasopharyngeal edema [20], therefore it is used by various authors in similar studies [4,5,20]. All patients were examined before the surgery, the first day (8–10 hours after the intervention) and the eighth to the tenth day after the intervention.

Depending on the type of data obtained, statistical processing was carried out by determining the main statistical indicators, non-parametric methods for independent (Mann—Whitney test) and dependent (Wilcoxon test) groups, as well as qualitative indicators (Fisher's exact test) using the STATISTICA program.

Results of the research and discussion

As a result of the intraoperative assessment of the torus tubarius, its hypertrophy was detected in 36 patients. The changes revealed were as follows: uniform thickening — 8 (22.2%) patients; a separate additional fold — 11 (30.5%) patients; an additional particle in the upper part of the torus tubarius, protruding into the choana — 20 (55.5%) patients. In 3 (8.3%) children, a combination of 2 types of increase was noted. In all cases, the changes were bilateral, but in 2 patients they were asymmetric (Fig. 1, 2).

In the literature, different types of TTH are described, from a slight increase to the state of «kissing tonsils», almost completely obstructing the lumen of the nasopharynx [12,22]. In a small

Table 2

Results of tympanometry in patients of the main and control groups

Groups	Intratympanic pressure (daPa)			Statistical significance (according to the Wilcoxon test)
	Before surgery M±m	On day 1 M±m	On day 8–10 M±m	
Main group (11 patients) n=22 ears	-43.57±27.13	-144.37±41.09	-39.15±14.85	$P_{1-2}<0.05$; $P_{2-3}<0.05$; $P_{1-3}>0.05$
Control group (8 patients) n=16 ears	-33.92±24.82	-95.00±27.90	-33.87±19.57	$P_{1-2}<0.05$; $P_{2-3}<0.05$; $P_{1-3}>0.05$
Difference between groups (Mann–Whitney criterion)	p>0.05	p<0.05	p>0.05	

Notes: Subscripts: 1 — Intratympanic pressure (daPa) before surgery; 2 — Intratympanic pressure (daPa) on day 1; 3 — Intratympanic pressure (daPa) on day 8–10.

number of scientific publications on the issue of TTH without middle ear pathology mostly describe cases of insufficient clinical effectiveness of primary adenoidectomy, when the correction of torus tubarius was carried out during a revision intervention [12,23]. Some authors consider LTTT hypertrophy to be a compensatory reaction to the removal of the pharyngeal tonsil, emphasizing that this situation was most common in children after adenoidectomy performed at an early age (at the age of 3 years and younger) [10,12]. However, the authors do not indicate the anamnestic data why these patients needed early adenoidectomy before the statistical age peak (3–7 years) [2].

The above-described changes in the torus tubarius were found in patients during the initial intervention, which indicates a possibly different genesis, and the symmetry of the changes suggests a systemic cause.

The data obtained during tympanometry of patients of the main and control groups are presented in Table 2.

According to the data presented in Table 2, intratympanic pressure in patients before the intervention was not significantly different, and was -43.57±27.13 daPa in children of the main group and -33.92±24.82 daPa in those of the control group.

A statistically significant decrease in intratympanic pressure was observed 6–8 hours after adenoidectomy in patients of both groups compared to the preoperative period, while the changes were more pronounced in patients of the main group (-144.37±41.09 daPa) in relation to those of the control group (-95.00±27.90 daPa) ($p<0.05$). The data obtained during the second measurement in the postoperative period (8–10 days after adenoidectomy) were as follows: -39.15±14.85 daPa in the main group and -33.87±19.57 daPa in the control group. It should be noted that the indicators obtained during the second examination after the surgery were significantly different from those in the early postoperative period ($p<0.05$), they reached the preoperative level ($p>0.05$) in both groups and corresponded to normal limits. Among the patients of both groups, there were no cases of complaints of ear congestion or hearing loss in the pre- and postoperative period.

Changes in intratympanic pressure on the first day after adenoidectomy were also detected by other researchers, including cases after power-assisted adenoidectomy [4,5,8,20], which were explained by postoperative swelling of the nasopharyngeal tissues and possible blocking of the ostium of the eustachian tube by blood clots [20]. In all these studies, the authors noted the normalization of intratympanic pressure on the seventh day after the intervention [4,5,20], which corresponds to the data obtained in patients of both studied groups, regardless of the fact that in the main group, torus tubarius correction was additionally performed.

Since the proposed method of the torus tubarius correction has no negative effect on the eustachian tube function, it can be recommended for use in clinical practice if reduction of the torus tubarius tissue is necessary.

Study limitations and prospect of further research. The obtained data on the spread of LTTT hypertrophy are described only in patients with concomitant clinically significant hypertrophy of the pharyngeal tonsil and without middle ear pathology, so they cannot be considered an indicator of the spread of this phenomenon in this age group.

A small sample did not allow for a detailed analysis of the prevalence of LTTT hypertrophy and the result of its correction in various concomitant pathologies of the middle ear and sinuses, as well as probable systemic causes (presence of allergies, viral load, etc.) and requires further study.

Conclusions

During the primary adenoidectomy, 31.3% of patients have TTH.

Torus tubarius correction during endoscopic power-assisted adenoidectomy leads to a more pronounced decrease in intratympanic pressure (by 55.0 daPa, $p<0.05$) in the early postoperative period (the first day), which is transient, and when examined on the eighth-tenth day, the difference in pressure in relation to the initial level and between groups is not detected.

Microdebrider technique for the correction of TTH is effective and safe and can be recommended for implementation in health care practice.

No conflict of interests was declared by the authors.

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