DOI: 10.5281/zenodo.3866008
UDC: 616.211/.216-07-053.2

Contemporary diagnosis of rhinosinusitis in children

***Mariana Turcan, Mihail Maniuc**

Department of Otorhinolaryngology
Nicolae Testemitanu State University of Medicine and Pharmacy, Chisinau, the Republic of Moldova

Authors' ORCID iDs, academic degrees and contributions are available at the end of the article

*Corresponding author: turcan.mariana92@gmal.com

Manuscript received April 07, 2020; revised manuscript May 29, 2020; published online June 10, 2020

Abstract

Background: Inflammatory disease of the paranasal sinuses, due to its high incidence in the nosological structure of morbidity, is a constant problem of modern otorhinolaryngology. The purpose of this study was to assess the importance of modern investigative methods for establishing the diagnosis in children with inflammatory rhinosinusitis.
Material and methods: The study was conducted on a group of 55 children, aged 4 to 18 years, diagnosed with inflammatory rhinosinusitis, hospitalized during the 2017-2020 years within ENT Department of *Emilian Cotaga* Republican Clinical Hospital for Children, Chisinau. The retrospective analysis of the data, retrieved from the clinical observation sheets and their attached documents, as well as from inpatient surgical protocols, during the years 2017-2020, was carried out.
Results: The applied diagnostic methods were as following: optical endoscopy, rhinomanometry, acoustic rhinometry, mucociliary clearance, computed tomography.
Conclusions: The study revealed that computed tomography and optical endoscopy provide an accurate mapping of rhinosinusal structures. Nowadays, inflammatory rhinosinusitis is definitely diagnosed by highly accurate methods, namely the optical endoscopy and computed tomography that are "the gold standard". The functional tests such as rhinomanometry and acoustic rhinometry are used to assess permeability and endonasal geometry, as well as evaluation of respiratory function in children with rhinosinusitis. The mucociliary nasal clearance plays a major role in modern diagnostic algorithm, being an essential index in assessing the functional status of the nasal mucosa and performing the protective function.
Key words: paranasal sinus, rhinosinusitis, children, diagnosis, investigation.

Cite this article
Turcan M, Maniuc M. Contemporary diagnosis of rhinosinusitis at children. *Mold Med J.* 2020;63(2):34-39. doi: 10.5281/zenodo.3866008.

Introduction

The inflammatory disease of the paranasal sinuses, due to its high incidence of the nosological structure of morbidity, severe complications and adverse consequences on the child's health, has always been a relevant issue in modern otorhinolaryngology [1].

The inflammatory diseases of the paranasal sinuses is a major health problem in childhood, showing an incidence, ranging from 18-30% to 38-42%, which has been increasing by 1.5%-2% per year [2-4]. According to American researchers regarding the incidence of rhinosinusitis, it makes up 4.6% of all visits to general practitioner [1, 5, 6]. According to other scientists, sinusitis leads to complications in 5% cases of upper respiratory tract infections among children [7]. The data provided by ENT departments of healthcare institutions revealed that patients suffering from diseases of paranasal sinuses make up the majority in 62% of cases [5].

Pathogenesis and early diagnosis have been multicenterally studied by ENT specialists [8]. There are studies describing the importance of both anatomical and physiological features of the nose and paranasal sinuses in the pathogenesis of rhinosinusitis [3, 9-11]. The pathogenesis of recurrent and chronic sinusitis in modern relevant literature is termed as "cooperation" between the infection and the predisposing factors [12-14]. The methods of diagnosing rhinosinusitis in children have changed considerably in the last 10 years, due to the development and widespread implementation of functional diagnostic methods (acoustic rhinometry, rhinomanometry),as well as by diagnostic nasal endoscopy and CT imaging [9, 15-17].

One of the major symptoms in patients with rhinosinusitis is the nasal obstruction, which is actually a subjective parameter. An objective nose breathing assessment, to diagnose the inflammatory disease of paranasal sinuses, is currently being required by both practitioners and scientific researchers [18-20]. The emerging technologies have made it possible to investigate the physiological processes occurring within the nasal cavity, particularly the nasal breathing, as well as bring more objective evidence to these changes [15, 21, 22]. Currently, the assessment of nasal resistance via anterior active rhinomanometry has been increasingly applied in scientific research, thus allowing collecting data that are more detailed on the nasal structure [23, 24].

Both modern endoscopy techniques and complex imaging investigations, such as CT scan provide a framework for innovative research, in order to fully assess the impact of specific areas in the development and maintenance of chronic rhinosinusitis [25-27]. The endoscopic examina-

tions performed by flexible fibroscope or rigid endoscopes enable to identify specific blocked sinus areas, as well as to determine anatomical variations and bone abnormalities, which are highly important in the pathogenesis and development of the disease [1, 28].

The computed tomography of the coronary and axial sections provides a detailed examination of the abnormalities and anatomical variations of the lateral wall of the nasal fossa, as well as an objective assessment of recurrent or chronic sinusitis. CT provides a precise map of the paranasal sinuses, thus ensuring a good study of the normal anatomy of the nasal cavities and an accurate description of dangerous relationships, which might further lead to a more beneficial, exact and limited therapeutic approach [25, 28].

The anterior rhinomanometry provides a dynamic study of the nasal ventilation function, which includes the assessment of the nasal airway resistance by measuring total airflow volume and total resistance [16, 24].

Rhinomanometry also gives objective and quantitative evidences on nasal permeability that depends upon two parameters: differential pressure (Δp), flow (V). The differential pressure (Δp) is the pressure difference between the atmospheric pressure measured in nasal vestibules using a mask and the inspiratory and expiratory pressure assessed in choanae. The respiratory flow (V) refers to the airflow volume passing through the nostrils [15, 17, 18]. Anterior rhinomanometry is a method of choice. It confirms the nasal obstruction by providing objective data to the patient's subjective symptoms. Taking into account the etiological diagnosis, rhinomanometry provides detailed data upon the mechanism of nasal obstruction from an anatomical point of view, thus having an essential role in assessing the conservative or surgical treatment. Rhinomanometry justifies the importance of mucociliary clearance of the sinus cavities and is of secondary forensic relevance [15, 23].

Acoustic rhinometry is a relatively new method, based on the analysis of sound waves reflected from the nasal cavity walls, aimed to assess the lumen size of the nasal fossae, as well as the sites of a reduced airflow, thus allowing assessing the correlation between minimal cross-sectional area (MCA) of the nasal cavities and their anteroposterior dimension.

The acoustic rhinometry shows a clinical importance due to its ability to measure the dimensions of the nasal cavity, as well as to evaluate the nasal permeability in terms of a curve [16].

Normal mucociliary clearance is essential for the maintenance of a healthy sinus cavity. The mucociliary transport of the ciliated epithelium is an important defense mechanism of the nasal cavity that helps in removing foreign particles from the nasal cavity during inspiration. An impaired mucociliary clearance leads to stasis of sinonasal secretions on the pituitary surface and a decrease in sinus aeration, which leads to the development and maintainance of rhinosinusitis [15, 29].

Material and methods

The study was conducted on a group of 55 children, aged between 4-18 years old, diagnosed with inflammatory rhinosinusitis (acute, recurrent and chronic rhinosinusitis), hospitalized within the ENT department at *Emilian Cotaga* Republican Clinical Hospital for Children, Chisinau, during the years 2017-2020. The retrospective analysis of data, retrieved from the clinical observation sheets and their attached documents, as well as from inpatient surgical protocols, during the years 2017-2020, was carried out. The inclusion criteria were as following: the study of anamnesis, of general clinical and ENT investigations, CBC, nasal endoscopy, rhinomanometry, acoustic rhinometry, mucociliary clearance, paranasal sinus radiography, and CT scan.

Data analysis and processing was performed by using the Microsoft Office Excel 2016 program.

Nasal endoscopy has become an integral aspect of the diagnostic algorithm for rhinosinsitis. The study group included 44 children, who underwent endoscopic examination, which made up 80% of cases. Optical endoscopy was carried out after a proper nasal cavity toilette. While considering the children's age, their neuropsychic and behavioral patterns, as well as the increased reflexology of the pituitary, the diagnostic endoscopy was commonly performed under general anesthesia, which was applied immediately before the procedure. The anesthetic, used to numb the nasal pituitary, was performed 15-20 minutes before the patients were transported to the operating room, in order to "skeletalize" the lateral wall of the nostrils, which is a key moment in endoscopic examination.

Pediatric patients, who were more cooperative, underwent endoscopy under local anesthesia with 10% Lidocaine spray, following decongestion of the nasal mucosa by applying vasoconstritive gauze packing (as Naftizine 0.05% or Xylometazoline 0.05%) on the surface of the nasal mucosa. In these cases, the examination was performed in a sitting position of the patient with the head in slight deflection position. The examination was performed 4 times consecutively, which provided a systematic visualization of the nasal fossae and their lateral wall. The nasal endoscopy used Karl Storz set, which included a 4 mm rigid endoscope with a 0.30 and 70-degree view angle, a 2.7 mm rigid endoscope with a 30-degree view angle and a flexible endoscope, thus ensuring an accurate visualization of the internal surface of the nasal fossae.

ATMOS PC 2000 (Germany) guided by a simple standard menu, has a built-in printer and display. Rhinomanometry was performed in 60% of cases, viz. 33 children. The examination results were displayed on the screen of the rhinomanometer, as a Y / t graph or a rhinogram, as shown in fig. 1. The rhinomanometer was used to assess nasal permeability.

The difference in pressure between the choanae and inside the mask was measured, the values being converted into electrical signals via a differential pressure converter. The microprocessors further carry out the electrical signals

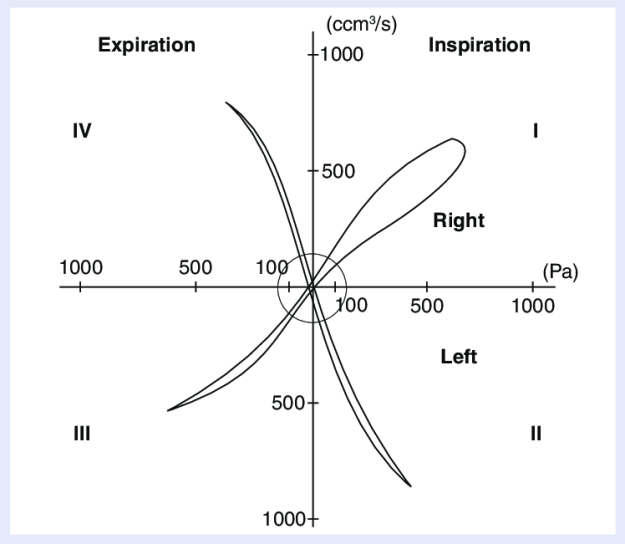

Fig. 1. Graphical representation of the RMM exam.

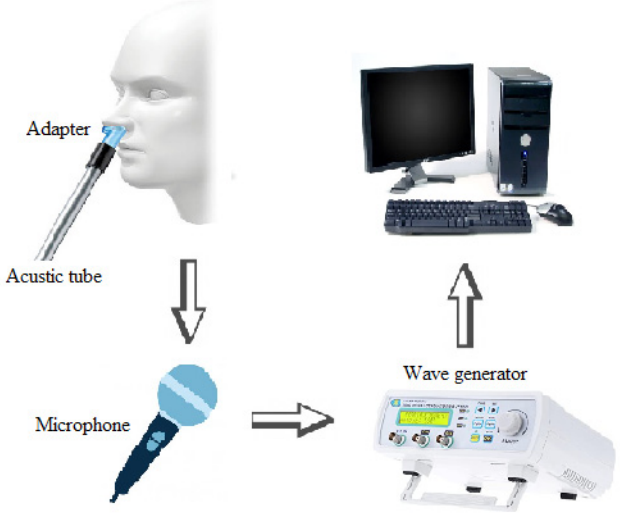

Fig. 2. Diagram of acoustic rhinometry devices.

processing. The concomitant measurement of the differential pressure and flow result in a flow-pressure curve, namely the nasal resistance curve. The examination was performed in a special room isolated from external noise, under constant temperature and humidity, the air temperature being 20-22°C. The patients spent about 20 minutes in the room in order to accommodate. The investigation was carried out in child's sitting position.

The device was mandatorily calibtared, prior to choosing the mask, the adapter depending on the nostril size and further being connected to the rhinomanometer tube. This technique uses a tube for measuring the choanae pressure that was fixed tightly to the nostril using a sponge nasal dressing. It is important to connect the mask, adapter and nostril airtight in order to avoid sound loss. The patient was examined during the apnea phase, at short intervals, as not to distort the obtained results by the changes in the pituitary mucosa caused by the nasal cycle. No rigid compression of the nostril was applied, as to prevent deformation of the nasal vestibule and changes in study results. The sound generator was turned on and the examination was carried out twice for each nostril. The investigation lasted about 3-4 minutes. A display of the mean curve for each nostril was shown on the rhinomanometer screen.

GM instrument 2000 was used to perform the acoustic rhinometry and study nasal cavity geometry. Computer assisted data analysis was carried out. The equipment includes an acoustic pulse generator with a frequency of 150 to 10000 Hz, an acoustic tube of 15 mm diameter and 580 mm long, a nasal adapter to connect the acoustic tube and the nostril, a microphone and computer (fig. 2).

30 children, namely 55% of cases underwent testing. They were tested under constant humidity and temperature conditions, whereas the noise did not exceed 60 dB. Children were assessed in the sitting position. The acoustic tube was at a 45-degree angle relative to the nostril. The patient spent about 20 min. to accommodate to the room environment prior to being tested. Each anatomical adapter was selected individually depending on the nostril size. The device was calibrated before the assessment. The child was instructed to hold his breath during the test. Display of the mean curve for each nostril was shown on the rhinometer screen. The study result was considered true, if the coefficient of variation of the curves did not exceed 1.15%.

The minimum cross-sectional (MCS) area and distance (D) at which these constrictions were located, and the nasal cavity volume (V) were studied. All data were processed on a computer and printed.

The mucociliary clearance was assessed in children from the main group via the saccharin test in 75% – 41 children. The standard procedure of this test is to place saccharin powder in the inferior nasal concha (saccharin can be colored blue), until the patient feels the taste of saccharin as time passes. The patient's cooperation is required, since he/she should report the sweet taste. It is forbidden for the patient to sneeze and blow the nose, as these might affect the position of the particles. Patients were instructed to swallow at least once per minute. It could be checked by blue staining of the pharynx. This method shows a mean mucociliary transport time (MTT) of about 10 minutes, though MTT up to 30 min is still considered a normal one.

CT examination was performed in 30 children – 50% of cases. It is essential in determining damages of the sinus structures, which are quite difficult to diagnose at rhinoscopy and endoscopy , as well as at X-ray. CT has a high diagnostic value for detecting impairment of the ostiomeatal complex and of the ethmoidal, sphenoidal sinus, which is impossible to assess via simple X-ray examination. The imaging study was carried out on axial and coronal planes, on a Siemens Somatom Emotion Duo computer tomography system. The fineness of the nasal bony structures and the paranasal sinuses require accurate and high-resolution cups. The CT assessment is essential for a precise study of sinus opacity and sinus wall integrity (normal, thin, and densified). In case of pediatric rhinosinusitis, CT imaging might reveal factors contributing to or maintaining the inflamma-

tory response of the rhinosinusal mucosa such as various abnormalities and anatomical endonasal variations: septal deviations at different segments, concha bullosa, paradoxically curved cornett and various deviations, excessive pneumatization of ethmoid bulla, etc. [22].

Results and discussion

Nasal endoscopy

The endoscopic examination, performed in children from the study group, was mostly aimed to examine the middle nasal meatus by visualizing pathognomonic changes of rhinosinusitis, thus mucosal edema was found in 90.9% of cases, congestion – in 84.09% of cases, presence of mucopurulent secretions – in 95.45% of cases. Another parameter to be monitored in patients with chronic rhinosinusitis was the presence of adenoid vegetation, found in 10 children, viz. 22.73% of cases.

Endoscopy enables to assess the presence of anatomical variations within the nasal fossae, which exhibit a pathogenic role in chronic rhinosinus: nasal septum deviation was recorded in 50% of patients, concha bullosa – 25%, paradoxically curved cornett / concha – 20.45%. The data are shown in fig. 3.

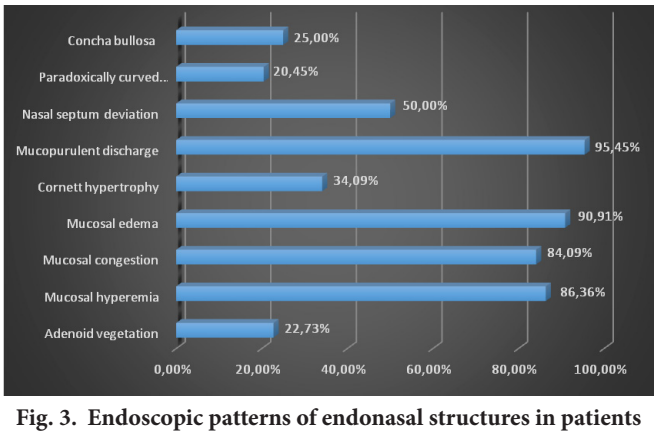

Fig. 3. Endoscopic patterns of endonasal structures in patients from the study group.

CT scan

CT scan revealed the following paranasal sinus impairment: edema of the sinus mucosa was found in 26 cases (86.67%), hydro-aerial level – in 14 cases (46.67%), opacification of ethmoid cells – in 14 cases (46.67%).

The study and analysis of computed tomography images was mainly aimed at detection and describing septal deviations in children from the study groups, since it may block the structures of the ostiomeatal complex, thus contributing to the inflammatory response. CT can determine the particular deviation site and its patterns (deformation, thickening or pneumatization of the nasal septum). The results of the CT scan showed a frequent deviation of the nasal septum in children from the study groups with an incidence of 22 cases (73.33%). The studies on the physiology and pathophysiology of the nose and paranasal sinuses regarding the occurrence and subsequent development of the chronic inflammatory process of the paranasal sinuses pay special attention to the anatomical factor, namely the presence of abnormalities and anatomical variations, particularly those that occur in the ostiomeatal complex. Thus, concha bullosa, was found in 9 (30%) cases, paradoxically curved middle cornett – in 7 (23.33%) cases, Haller cells – in 5 (16.67%), pneumatization of the ethmoid bulla – in 15 (50%) and accessory maxillary sinus ostium – in 3 (10.00%) cases. The data are shown in fig. 4.

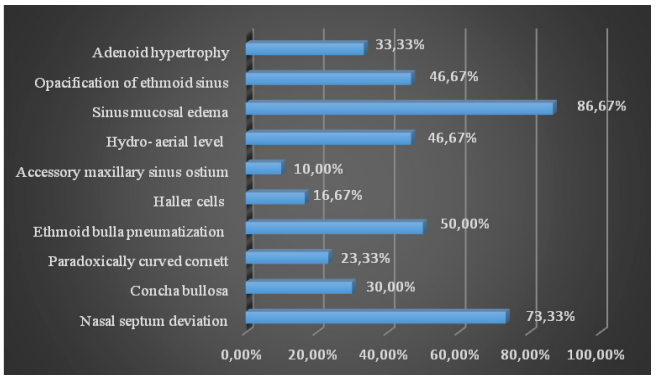

Fig. 4. Structural changes and variations of endonasal anatomy in patients from the study group.

Rhinomanometry

An objective study of nasal resistance revealed signs of nasal congestion in children from the main group. According to specialized literature, the indices of nasal structures in healthy children are as following: total volume at 150 Pa – 564 cm / sec. and total resistance at 150 Pa – 0.37 Pa / cm^3 / sec. The study revealed mild nasal obstruction in 5 (15.15%) cases, moderate obstruction in 19 (57.58%) cases and severe obstruction was reported in 9 (27.27%) cases. Data analysis of Figure 5 shows that children with chronic and recurrent rhinosinusitis from the study groups exhibited a reduced total volume of the nasal fossa, compared to the normal ranges. There is an increase of total resistance at 150 Pa in the main group, compared to the control one.

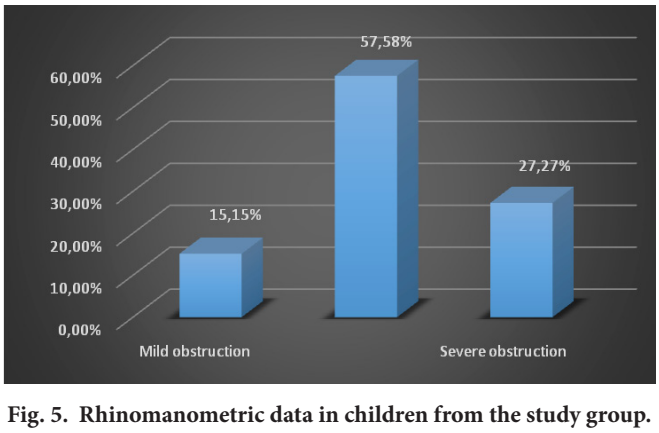

Fig. 5. Rhinomanometric data in children from the study group.

Nasal permeability was studied by acoustic rhinometry. The obtained data revealed that patients from the study group exhibited changes in the endonasal geometry, characterized by a decrease of the nasal fossae volume and a re-

duced minimum cross-sectional area. The results are shown in tab. 1.

Table 1

Acoustic rhinometric data in patients from the study group

Indices	Study group	Normal ranges
V (cm³)	2.76	5.7
A1(cm²)	0.382	0.790
D1 (cm)	1.29	0.940
A2(cm²)	0.420	0.780
D2 (cm)	2.81	2.68

Mucociliary clearance

The mucociliary clearance of the children included within the study was assessed by saccharin test. The normal mucociliary transport time (MTT) is about 10 min. MTT up to 30 min is also considered normal. The test results showed a mucociliary clearance time of ≤30 min in 6 (14.63%) patients, of 31-60 min – in 23 (56.10%) patients and > 60 min – in 12 (29.27%) patients. The results are shown in fig. 6.

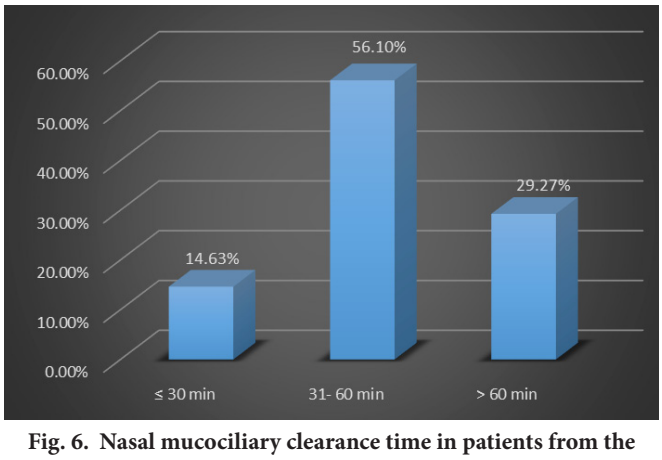

Fig. 6. Nasal mucociliary clearance time in patients from the study group.

Conclusions

1. Optical endoscopy provides a comprehensive and atraumatic assessment of the paranasal sinus structures and ostiomeatal complex, as well as helps to determine the anatomical variations that show a major impact in the development and maintenance of chronic rhinosinusitis.

2. CT scan enables an accurate visualization of the ostiomeatal complex, which is responsible for maintaining the recurrent and chronic rhinosinusitis, thus being considered important in surgical treatment.

3. Rhinomanometry provides objective evidence in studying nasal permeability and can be used to assess the total volume and resistance in patients with inflammatory rhinosinusitis.

4. Acoustic rhinometry opens up new perspectives and opportunities in the study of nasal passages and their pathological changes. Its non-invasive features, simplicity and speed are particularly important in pediatric practice.

5. The mucociliary clearance test is an essential diagnostic tool in assessing the functional status of the pituitary nasal mucosa and performing the protective function.

References

1. Fokkens WJ, Lund VJ, Hopkins C, Hellings PW, Kern R, Reitsma S, Toppila-Salmi S, Bernal-Sprekelsen M, Mullol J, Alobid I, Anselmo-Lima WT, et al. European position paper on rhinosinusitis and nasal polyps 2020. Rhinology. 2020;58(Suppl 29):1-464. doi: 10.4193/Rhin20.600.
2. Fadda GL, Rosso S, Aversa S, Petrelli A, Ondolo C, Succo G. Multiparametric statistical correlations between paranasal sinus anatomic variations and chronic rhinosinusitis. Acta Otorhinolaryngol Ital. 2012 Aug;32(4):244-51.
3. Polavaram R, Devaiah A, Sakai O, Shapshay SM. Anatomic variants and pearls–functional endoscopic sinus surgery. Otolaryngol Clin North Am. 2004 Apr;37(2):221-42. doi: 10.1016/S0030-6665(03)00161-0.
4. Smith SS, Ference EH, Evans CT, Tan BK, Kern RC, Chandra RK. The prevalence of bacterial infection in acute rhinosinusitis: a systematic review and meta-analysis. Laryngoscope. 2015 Jan;125(1):57-69. doi: 10.1002/lary.24709.
5. Goldenberg, D, Goldstein, BJ, editors. Handbook of otolaryngology. Stuttgart: Thieme; 2011. 774 p. doi: 10.1055/b-002-80417.
6. Hoffmans R, Wagemakers A, van Drunen C, Hellings P, Fokkens W. Acute and chronic rhinosinusitis and allergic rhinitis in relation to comorbidity, ethnicity and environment. PLoS One. 2018 Feb 5;13(2):e0192330. doi: 10.1371/journal.pone.0192330.
7. Revonta M. Ultrasound in the diagnostic of pediatric sinusitis. In: Pediatric Rhinology. Sienna; 1999. p. 17-26.
8. Kuiper JR, Hirsch AG, Bandeen-Roche K, et al. Prevalence, severity, and risk factors for acute exacerbations of nasal and sinus symptoms by chronic rhinosinusitis status. Allergy. 2018 Jun;73(6):1244-1253. doi: 10.1111/all.13409.
9. Bidilean N. Concordanţe morfo-clinice, radiologice şi endoscopice în afecţiunile inflamatorii rinosinuzale [Morpho-clinical, radiological and endoscopic concordances in inflammatory rhinosinusal diseases]. Otorhinolaryngol. 1997;18(3-4):37-45. Romanian.
10. Bhattacharyya N, Lee KH. Chronic recurrent rhinosinusitis: disease severity and clinical characterization. Laryngoscope. 2005 Feb;115(2):306-10. doi: 10.1097/01.mlg.0000154738.40690.
11. Orlandi RR. A systematic analysis of septal deviation associated with rhinosinusitis. Laryngoscope. 2010;120(8):1687-95. doi: 10.1002/lary.20992.
12. Alkire BC, Bhattacharyya N. An assessment of sinonasal anatomic variants potentially associated with recurrent acute rhinosinusitis. Laryngoscope. 2010 Mar;120(3):631-4. doi: 10.1002/lary.20804.
13. Godley F, Casiano R, Mehle M, McGeeney B, Gottschalk C. Update on the diagnostic considerations for neurogenic nasal and sinus symptoms: a current review suggests adding a possible diagnosis of migraine. Am J Otolaryngol. 2019 Mar - Apr;40(2):306-311. doi: 10.1016/j.amjoto.2018.09.021.
14. Loftus PA, Lin J, Tabaee A. Anatomic variants of the paranasal sinuses in patients with recurrent acute rhinosinusitis. Int Forum Allergy Rhinol. 2016 Mar;6(3):328-33. doi: 10.1002/alr.21658.
15. Clemens PA. Standartization of rhinomanometry. Rhinology. 1986;22(3):151-155.
16. Liukkonen K, Virkkula P, Pitkäranta A. Acoustic rhinometry in small children. Rhinology. 2006;44(2):160-163.
17. Sivasli E, Sirikci A, Bayazyt YA, et al. Anatomic variations of the paranasal sinus area in pediatric patients with chronic sinusitis. Surg Radiol Anat. 2002;24(6):400-5.
18. Teixeira RUF, Zappelini CEM, Alves FS, da Costa EA. Peak nasal inspiratory flow evaluation as an objective method of measuring nasal airflow. Braz J Otorhinolaryngol. 2011,77(4):473-80. doi: 10.1590/s1808-86942011000400011.
19. Villwock JA, Kuppersmith RB. Diagnostic algorithm for evaluating nasal airway obstruction. Otolaryngol Clin North Am. 2018 Oct;51(5):867-872. doi: 10.1016/j.otc.2018.05.002.
20. Vogt K, Wernecke K-D, Behrbohm H, Gubisch W, Argale M. Four-phase rhinomanometry: multicentric retrospective,clinical measurements.

Eur Arch Otorhinolaryngol. 2016 May;273(5):1185-98. doi: 10.1007/s00405-015-3723-5.
21. Budu VA. Tehnici actuale în chirurgia etmoidului [Current techniques in ethmoid surgery] [dissertation]. Bucharest: Carol Davila University of Medicine and Pharmacy; 2003. 170 p. Romanian.
22. Dinis PB, Haider H, Gomes A. Rhinomanometry, sinus CT-scan and allergy testing in the diagnostic assessment of chronic nasal obstruction. Rhinology. 1997;35(4):158-160.
23. Gofman VR, Kiselev AS, Gerasimov KV. Rinomanometriia v diagnostike khronicheskikh rinitov [Rhinomanometry in the diagnosis of chronic rhinitis]. [Russ Rhinol]. 1994;(Suppl 2): 23-24. Russian.
24. Lang C, Grutzenmacher S, Mlynski B, Plontke S. Investigating the nasal cycle using endoscopy, rhinoresistometry, and acoustic rhinometry. Laryngoscope. 2003;113(2):284-289. doi: 10.1097/00005537-200302000-00016.
25. Brooks SG, Trope M, Blasetti M, Doghramji L, Parasher A, Glicksman JT, et al. Preoperative Lund-Mackay computed tomography score is associated with preoperative symptom severity and predicts quality-of-life outcome trajectories after sinus surgery. Int Forum Allergy Rhinol. 2018 Jun;8(6):668-675. doi: 10.1002/alr.22109.
26. Larsen KL, Lange B, Darling P, Jorgensen G, Kjeldsen AD. The validity of nasal endoscopy in patients with chronic rhinosinusitis. Clin Otolaryngol. 2018 Feb;43(1):144-150. doi: 10.1111/coa.12916.
27. Tiwari R, Goyal R. Study of anatomical variations on CT in chronic sinusitis. Indian J Otolaryngol Head Neck Surg. 2015 Mar;67(1):18-20. doi: 10.1007/s12070-014-0734-2.
28. Rimmer J, Fokkens WJ, Hellings P, Lund VJ, Alobid I, Beale T, Dassi C, Douglas R, Hopkins C, Klimek L, Landis B, Mosges R, Ottaviano G, Psaltis A, Surda P, Tomazic PV, Went J. European position paper on diagnostic tools in rhinology. Rhinology. 2019;57(Suppl 28):1-42. doi: 10.4193/Rhin19.410.
29. Sauvalle M, Alvo A. Effect of the temperature of nasal lavages on mucociliary clearance: a randomised controlled trial. Eur Arch Otorhinolaryngol. 2018 Sep;275(9):2403-2406. doi: 10.1007/s00405-018-5060-y.

Authors' ORCID iDs and academic degrees
Mariana Turcan, MD – https://orcid.org/0000-0002-7561-3886.
Mihail Maniuc, MD, PhD, Professor of Otorhinolaryngology – https://orcid.org/0000-0002-5340-5779.

Authors' contributions
MT designed the trial and drafted the first manuscript; MM interpreted the data and revised the manuscript critically. Both authors revised and approved the final version of the manuscript.

Funding
This study was supported by *Nicolae Testemitanu* State University of Medicine and Pharmacy. The trial was the authors' initiative. The authors are independent and take responsibility for the integrity of the data and accuracy of the data analysis.

Ethics approval and consent to participate
The study was approved by Research Ethics Committee of *Nicolae Testemitanu* State University of Medicine and Pharmacy (protocol No 5 of April 15, 2020). It was obtained an informed consent from all participants in the study.

Conflict of Interests
No competing interests were disclosed.