Implementation of Uncertainty Calculation Elicited from Paranasal Sinuses Bones' Structural Parameters for Various Approaches to Treat Recurrent Poliposus

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Abstract

The problem of polyposus recurrent rhinosinusitis is extremely pressing today.

The aim of our study was to implement the uncertainty measurement of the bone structure parameters of the paranasal sinuses for different ways of the treatment of the recurrent polyposus rhinosinusitis.

Material and Methods. 400 people were included to the current study. 300 patients of the study group were divided into three groups (100 patients in the each one), depending on the treatment type they received.

Results. In the group of patients who underwent surgical treatment, vaccination both with the prescription of the intranasal glucocorticosteroids, rather low density values were also observed.

Conclusions. Uncertainty measurements were implemented to the calculation of the bone density in different groups of patients. Obtained results provided strong evidence that patients who had undergone that treatment were highly unlikely to develop complications and/or recurrences.

Keywords 1

Recurrent poliposus rhinosinusitis, bone density, computed tomography, uncertainty

1. Introduction

Modern scientific approaches play an important role in a different branches of medicine and science [1-3]. Recurrent poliposus rhinosinusitis (RPRS) accounts for significant overall burden of chronic diseases of nasal cavity that puts it into limelight of modern otorhinolaryngology [4].

Recurrence of rhinosinusitis can ensue from various events that make direct or mediated impact on different links of sophisticated chain weaving the pathogenesis of this disease. In particular driving cause, presence or absence of comorbidities (for example bronchial asthma), morphological features of nasopharynx and choice of treatment are the main contributors that predetermine the outcome. In particular, etiology, the presence or absence of concomitant diseases (for example, bronchial asthma), the morphological features of the nasopharynx or oropharynx [5-6], presence or absence of bad habits [7-9] and the choice of the optimal method of treatment [10]. There are several conventional approaches for treatment of RPRS. Although ample data have shed light on immune pathways giving rise to RPRS, unfortunately surgical procedure remains as a mainstream intervention. However used

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solely surgical management has high [11] odds to fail with respect to accomplished cure as well as some postoperative disturbances experienced by majority of patients and therefore affected quality of life, reduced timespan between relapses under condition of lingering causative drivers of RPRS. However many publications target is involvement of allergic disorders, but infectious immunity contribution to sparkling of RPRS is often skipped by scrutiny. Considering immune response as the pivotal protective measure against infectious agents, significance of search and development of new means to modulate immune response can't be overestimated.

Efficacy of treatment predetermines risk of recurrences. Nowadays there is no consolidated and unified conception regarding pathogenesis of recurrent course of RPRS, however the mainstay of modern view at this issue considers attrition of bone density stemmed from overwhelming predominance of bone alteration and resorption fuelled by long-lasting inflammatory foci nestling in the mucus lining of paranasal sinuses. Besides the other opinion claims that particularly bone density rather than thickness of these bones plays the key role in recalcitrant course of RPRS and risk of complications.

In the accordance to everything was mentioned above, **the aim** of our study was to implement the calculation of uncertainty of the bone structure parameters of the paranasal sinuses for different ways of the treatment of the recurrent polyposis rhinosinusitis.

2. Material and Methods

The study included 400 people who were divided into 4 groups. The control group were formed of 100 people without some signs of rhinosinusitis. The spiral computed tomography (SCT) examination was carried out due to an unrelated pathology of the ENT organs (for example, a suspicion of a stroke, which was not confirmed). The first study group included 100 people with signs of chronic polypous rhinosinusitis , who underwent only surgical treatment of the disease. The second group was formed from 100 people. The surgical treatment of patients of this group was supplemented by the appointment of intranasal glucocorticosteroids. Finally, 100 patients of the third group underwent surgical treatment were prescribed vaccination according to the author's method.

Autovaccine is a suspension of concentration of 101 macrocarganisms, which were taken from the inflammatory source. A skin test by the prick test method was provided before the using of the autovaccine. During the first stage (3–5 tests in the fallow period due to individual reactions), the patient took 8 injections of autovaccines. Injections of the first stage of vaccine therapy were carried out 1 time for 2-3 days, constantly increasing the dose (first injection - 0.1 ml, second - 0.2 ml, third - 0.3 ml, fourth - 0.4 ml, fifth - 0.5 ml, sixth - 0.6 ml, seventh - 0.8 ml, eighth - 1.0 ml). After the first stage was complete, there was a break with a diapason of 3-4 days. After the interruption, another stage of vaccine therapy was carried out/This stage consisted of seven injections of autovaccine, which were carried out 1 time for 2-3 days, the skin dose was once increased by 0.2 ml (first injection - 0.1 ml, the other - 0, 3 ml, third - 0.5 ml, fourth - 0.7 ml, fifth - 0.9 ml, sixth - 1.1 ml, seventh - 1.3 ml).

All groups were similar according to the anthropometric indicators and basic clinical parameters. All the participants gave voluntary information to participate in the current study.

All patients underwent CT scan according to the EPOS recommendations. To provide CT examination Toshiba Aquillion tomograph (Japan) was used. Subsequently, the obtained images were processed by the RadiANT DICOM viewer program. In all groups, bone density indicators were calculated using Hounsfield units, and afterwards the uncertainty of the density indicators of the upper wall of the maxillary sinus was calculated. Attention was paid to the upper wall of the Maxillary sinus as it is potentially dangerous for the development of intraorbital complications.

Uncertainty is an internationally accepted measurement.

All contributions of the uncertainties of the input quantities form the standard uncertainty of the measured quantity u(Sn) (the total standard uncertainty uc, which is calculated according to the rule of summation of variances.

On the first step of our study calculating the total standard uncertainty of measurement the density was performed using the formula:

$$u_c(H_H) = u_A^2(H_{Hi}) + u_B^2(H_{Hi}) \quad (1),$$

where $u_A(H_{Hi})$ is the type A standard uncertainty, $u_B(H_{Hi})$ is the type B standard uncertainty.

To calculate the standard uncertainty of type A, the following formula was used:

$$u_A(H_{Hi}) = \sqrt{\frac{n}{n-1}\sum_{i=1}^{n}(H_{Hi} - H_H)^2} \quad (2),$$

where H_{Hi} is the i-th value of the sample measurements, H_H is the mathematical expectation, n is a number of measurements in the sample.

The calculation of the standard uncertainty of type B was calculated according to the formula:

$$u_B(H_H) = H_H \frac{\delta_H}{\sqrt{3} \cdot 100} \quad (3),$$

where δ_H is the measurement error of the software, which does not exceed 0.0001% [&&&].

On the next step the interval uncertainty estimate, namely the expanded uncertainty U was calculated according to the formula

$$U = k \cdot U_C \quad (4),$$

where k is the coverage factor.

The coverage factor depends on the distribution of the measured value and the level of confidence p which was chosen. For these samples, the hypothesis of a normal distribution is confirmed, therefore, the coverage coefficient for a p = 0.95 is assumed to be 2.

3. Results

In the course of the study, the indicators of the structure of the upper wall of the maxillary sinus were determined in all groups of patients and the results are present in the table 1

Table 1

Results of the values calculation of the total standard uncertainty for measurements of the upper wall's maxillary sinus density

Head 1	$U_A(H_H)$	$U_B(H_H)$	U_c	U
Control group	197,67	-0,00003767	19,76	39,53
Patients of the 1st gr	119,12	0,00002858	11,91	23,82
Patients of the 2nd gr	139,36	0,00001980	13,94	27,87
Patients of the 3d gr	196,75	0,00000641	19,68	39,35

Thus, as can be seen from the table, the maximum value of bone density was typical for a group of people under physiological conditions. In this case, the standard uncertainty for type A was 197,67 Hu, the standard uncertainty for type B was -0,00003767 Hu, the total standard uncertainty is , the expanded uncertainty was 39,53 Hu.

In the group of patients who underwent only surgical treatment, the worst result was obtained according to the comparison with the rest of presented patients groups. In this group of patients, the type A standard uncertainty was 119,12 Hu, the type B was 0,00002858 Hu, the standard uncertainty was 11,91 Hu, the total standard uncertainty was 23,82 Hu.

In the group of patients who underwent combined treatment (surgical treatment both with the prescription of intranasal glucocorticosteroids) the indicators were somewhat higher, although they differed from the control group of individuals under physiological conditions. the standard uncertainty for type A was 139,36 Hu, the standard uncertainty for type B was 0,00001980 Hu, the total standard uncertainty was 13,94 Hu, the expanded uncertainty was 27,87 Hu.

In the group of patients who underwent surgical treatment, vaccination both with the prescription of the intranasal glucocorticosteroids, rather low density values were also observed. The standard

uncertainty of the type A was 196,75 Hu, the standard uncertainty for type B is 0,00000641 Hu, the total standard uncertainty was 19,68 Hu , the expanded uncertainty was 39,35 Hu (see table 1).

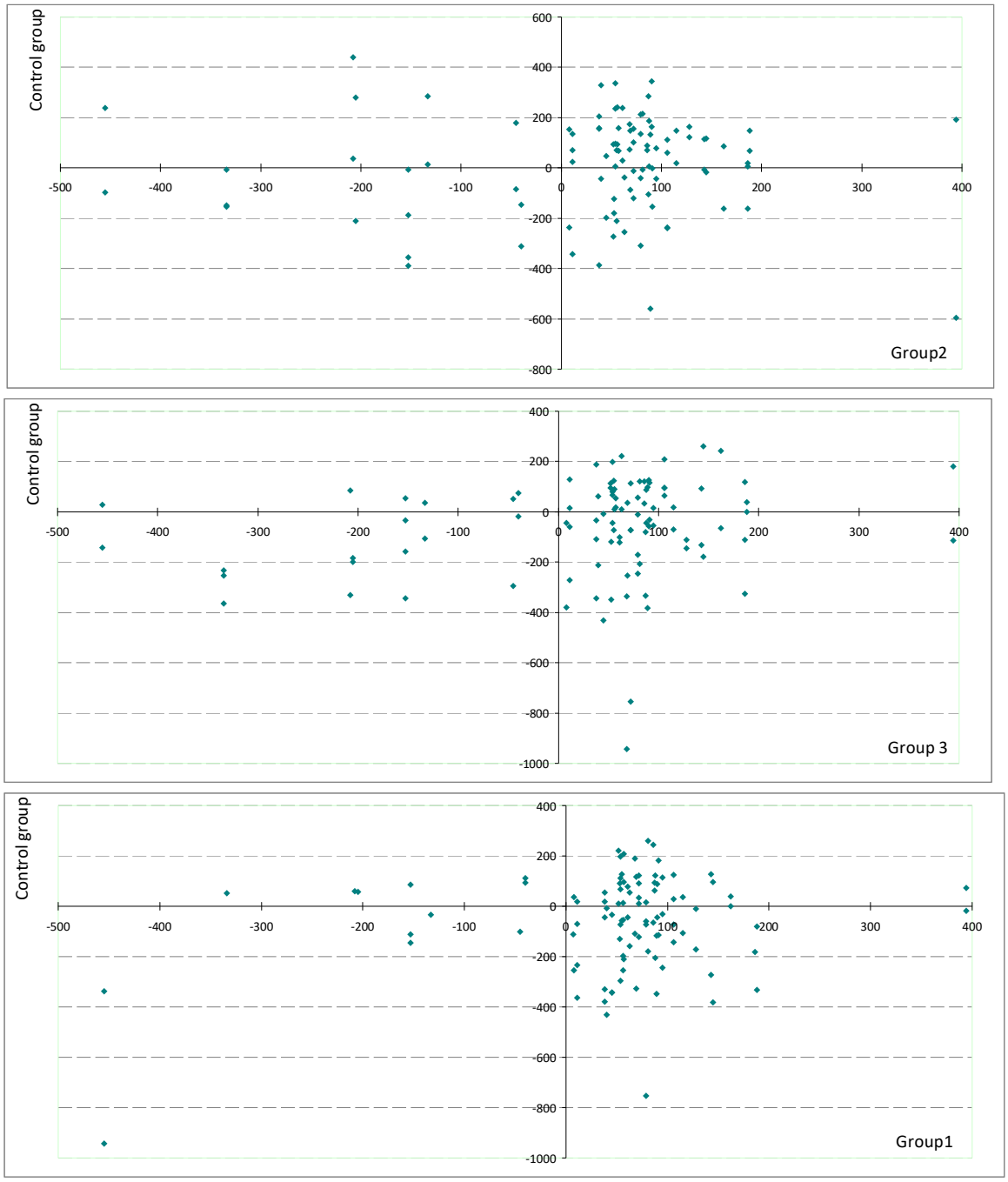

Figure 1: Results of the density calculation in the different groups of patients

4. Discussion

This study devoted to pressing concern of modern otorhinolaryngology, namely RPRS, came as pioneering in the field, because it had put under the close scrutiny deranged immune response locked into vicious circle, elicited pieces of evidence sufficient to develop approach with use of autovaccine preceding surgical intervention confined to endoscopic polypectomy following by endonasal corticosteroid spray use. Efficacy of different approaches for treatment that patients had undergone

according to allocated group was evaluated by bone density as a cornerstone for predicting the risk of impending complications and fending them off.

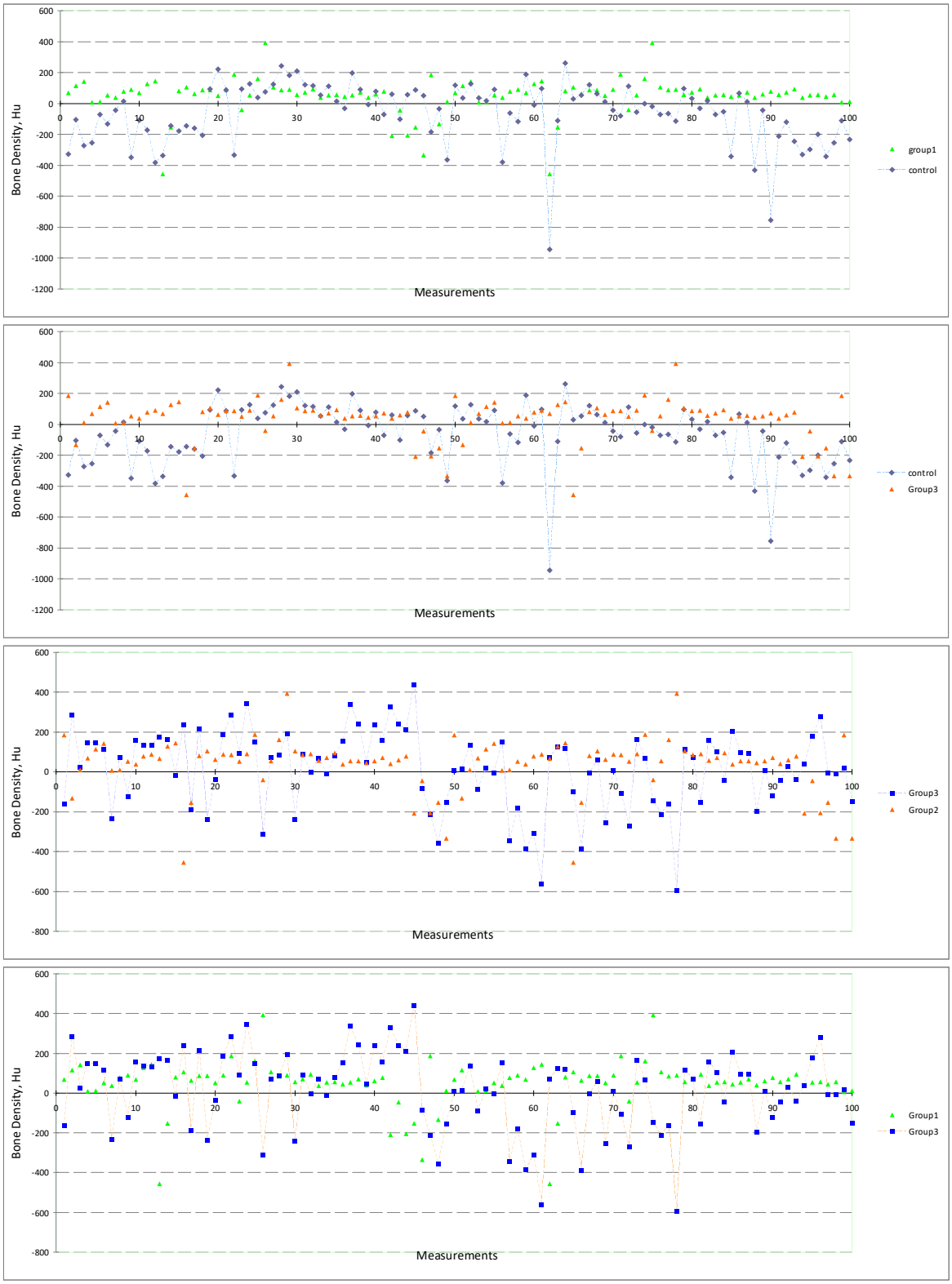

Figure 2: Comparison of the results of density calculation in the different groups of patients

Taking into consideration variability of targeted parameter and its challenging measurement we introduced calculation of uncertainty as the leverage to manage this hurdle and neutralize inaccuracy of calculus.

RPRS could be detected in many people with a lot of supportive diseases[12, 13] and requires modern approaches to its diagnostics [14,15] and new approaches for the treatment [16].

This approach also was engaged for the first time for assessment of patients with RPRS within framework of our study. It is worth mentioning that although RPRS poses a substantional concern from the point of view of promptitude and effectiveness of its treatment, this issue has received low attention from evidence-based medicine. For example, one of the few studies published recently was research of [17], the authors claimed advantage of combined macrolides and corticosteroids over the solely use of antibiotics separately from intranasal corticosteroids. They also used SCT as the marker of the treatment's efficacy, but the size and location of polyps were regarded of much more significant value than SCT though. The structure of bones of maxillar sinuses wasn't evaluated at all. In our study precisely morphological features of upper jaw's bone was the target of scrutiny, namely the density of the top wall that was stipulated by its significance in averting intraorbital complications. As it can be judge at the base of figure 2 the lowest bone density was revealed in patients who had undergone solely endoscopic polypectomy.

This study could be perspective for the detection of the uncertainty parameters of the bone density in different groups of patients, with different anthropometric data [18, 19], using new and informative diagnostical methods [20-22].

The conclusion can be drawn that exactly this surgical procedure as the conventional management of RPRS across the world might have been intimately related with intraoperative and long-term postoperative complications. Furthermore particularly these patients were much more likely to develop frequent recurrences. A bit better results of treatment were recognized among patients who had undergone postoperative streak of intranasal corticosteroids (figure 2). However it turned out those patients who had completed the full course including autovaccine, intranasal corticosteroids together with adequate endoscopic polypectomy showed the best bone density of upper wall of maxillary sinus (figure 2). Thus we can infer that holistic approach for treatment of RPRS was associated with the highest effectivenes as it can have gotten reach of involved major causative factors and by those means prevented from recurrences and complicated course of the disease.

5. Conclusions

Our study was the first to evaluate the bone density of maxillary sinus among patients with RPRS with respect to the type of prescribed treatment. It turned out the best bone density was revealed in patients who had completed combine treatment (autovaccine, intranasal corticosteroids followed by endoscopic polypectomy). the maximum value of bone density was typical for a group of people under physiological conditions. In this case, the standard uncertainty for type A was 197,67 Hu, the standard uncertainty for type B was -0,00003767 Hu, the total standard uncertainty is , the expanded uncertainty was 39,53 Hu. Obtained results provided strong evidence that patients who had undergone that treatment were highly unlikely to develop complications and/or recurrences.

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