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Radiometric measurements and evaluation of Radon concentration in some Northern Romanian salt mines for speleo-therapeutic, medical purposes and balneary tourism

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ABSTRACT

The knowledge of radon concentration levels in underground environments is essential for therapeutic purposes of different respiratory and rheumatic diseases. In order to develop speleo-therapy in Romania, this paper presents the results of an indoor radon concentration levels survey in some salt mines in Romania. The survey was carried out using radon monitor Pylon system methodology. In order to investigate whether differences in depth and microclimate parameters translate into significant differences in salt mine indoor radon concentrations, have been chosen three salts mine test sites placed in the Northern part of Romania: Cacica, Ocna Dej and Ocna Turda in stable areas of the mining field at 32-240 m depth. Environmental microclimate conditions (mean values of air temperature 10-14.5 °C, air humidity 65–80 %, air velocity 0.2 m/s saline aerosols and low microbial factors) have anti-bacterial, anti-microbial, and anti-inflammatory properties and recognized therapeutically effects on human body's health. The measuring of the natural background ionizing radiation in salt mines was made using the Berthold Umo LB portable integrated impulse debit meter (used in rate mode) equipped with a gamma probe - Counter-timer and an integration time of 3600 s/measure. The measurement and calibration procedures were conducted in conformity with the procedures of the accredited (SR EN ISO/CEI 17025: 2005) SALMROM laboratory. The analyzed environmental conditions and recorded low levels of indoor mean radon concentration (6.9 ± 0.39 and 96.5 ± 4.76 Bq/m³) demonstrated the best suitability of the investigated three salt mines in Romania for speleo-therapeutic applications.

Key words: Speleo-therapy, Salt mines, Radon concentration, Radiometric measurements

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INTRODUCTION

Radon (²²²Rn) and its short-life decay products (²¹⁸Po, ²¹⁴Pb, ²¹⁴Bi and ²¹⁴Po) and thoron (²²⁰Rn) and its daughters (²¹⁶Po, ²¹²Pb, ²¹²Bi and ²¹²Po) are alpha-, beta- and gamma-emitting nuclei. Inhalation of these radionuclides, which occur in the free atmosphere and in their higher concentrations in indoor air, represents the main source of exposure to ionizing radiation for population in most countries. The great part of the natural radiation dose is not from radon itself, but from the short-lived alpha particles (radon daughters), most notably ²¹⁸Po (radioactive, $T_{1/2} = 3$ min), and ²¹⁴Po (radioactive, $T_{1/2} = 0.164$ ms), along with beta particles from ²¹⁴Bi ($T_{1/2} = 19.7$ min), where $T_{1/2}$ is physical half-life. [1,2].

The exposure to radon and its progeny can lead, in certain situations at lung cancer and bronchial tissue damage [3] or can be beneficial in low level radon therapy of various diseases such as: rheumatoid arthritis, inflammatory rheumatologic conditions, and ankylosing spondylitis [4]. The beneficial effect of low level radon therapy has gained recognition by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) [3, 4].

The subterranean environments (caves and mines) have a considerable widespread use in some Central and Eastern European countries (Austria, Azerbaijan, Bulgaria, Byelorussia, Germany, Hungary, Kyrgyz, Poland, Russia, Switzerland, Ukraine) for the treatment of respiratory and allergic dis-

eases [5-7] due to their air quality, underground climate and low level radiations.

Measurement of radon is of interest both for the health risk assessment and for development of radon therapy in enclosed spaces like as caves, mines, spas. In Romania, radon therapy is not in use, yet. The development of alternative treatment method of rheumatologic conditions in mines in Romania implies primarily, the evaluation of radon levels in these mines.

Romania is one of the richest European countries in natural deposits of salts, some of them forming massive salt domes, which appear as a result from high pressure that pushes the salt up through the rocks from great depths.

Such domes, mainly encountered in the sub-Carpathian region have been worked since ancient times and now host a multitude of active as well as decommissioned salt mines, the last one representing ideal location for treatment facilities. Due to low level of natural radioactivity, compared with other geological formations, rock salt mines and caves seems to be one of the most suitable environment for respiratory and rheumatic therapeutic purposes [2]. The oldest and largest salt mines found are: Turda, Praid, Cacica, Ocna Dej, and Slanic Prahova.

The purpose of the study is to evaluate the activity concentrations and distribution of natural radionuclides in Cacica, Ocna Dej and Ocna Turda salt mines, considering future development of the speleo-therapy in these salt mines. The radon, gamma ray, gross alpha and gross beta radiation measurements have demonstrated the presence in low concentrations of natural radionuclides in rock salts collected from different points of the salt mine and sustain the development of speleo-therapy in these mines.

MATERIALS AND METHODS

For the analysis of radon concentration levels in this study have been chosen three salt mines test sites placed in the Northern part of Romania (Fig. 1), defined by following geographical coordinates [2]:

- Cacica: (47° 38'06.51" N/25° 53'52.55" E-47° 38'17" N/25° 54'0" E);
- Ocna Dej: (46°35'17.45" N/23°47'12.45" E-47° 06'46.61" N/23° 51'40.61" E);
- OcnaTurda: (46° 35'3.08" N/23° 46'38.55" E-46° 35'17.45" N/23° 47'12.45" E.

2.1. Measurement of radon concentration

The experimental data consisted of radon volume activity measurements (in situ) and determination (in laboratory) of the specific activity of radionuclides of uranium-, thorium- and actinium-series in salt samples. The following specialised equipment and measurement systems have been used: portable monitor to measure atmospheric radon, Pylon model AB-5, Pylon Electronics Inc. and UMO Universal Monitor LB 123, Berthold Technologies, gamma spectrometry system with HPGe detector (model ORTEC) for measuring the activity of gamma emitting radionuclides contained in the samples. The measurements and calibration procedures

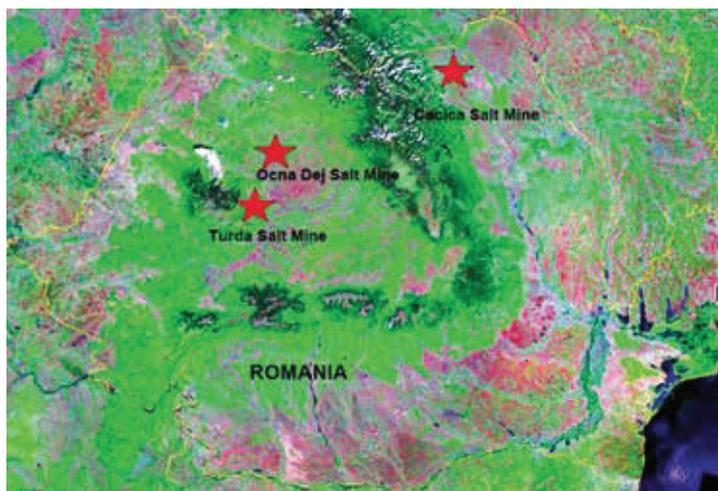


Figure 1. Investigated salt mine test areas on Romania's map.

were conducted in conformity with the procedures of the accredited SR EN ISO/CEI 17025: 2005 SALMROM laboratory (*System Calibration Report* and *SALMROM Quality Manual* – SR EN ISO/CEI 17025: 2005). The measuring devices, Pylon model AB-5 portable radon monitor (Pylon Electronic Development Company Ltd., Canada) consists of CPRD passive scintillation cell detector (ZnS(Ag)), in <radon mode> usage. The radon concentrations for a predetermined time interval were stored in the system memory and subsequently transmitted to a computer. This system was used in radon mode with the calibration factor of $0.0421 \pm 4\%$ cpm/(Bq/m³) [8, 9, 10]. The data recorded for the first three hours were not taken into account, because this time is necessary for the system to reach its equilibrium point. All calculations were done considering the measured natural background radiation of 0.2 cpm [8, 9, 10]. The radon concentration was calculated using relation (1):

$$C_{Rn} = \frac{CPM/INT - B}{S} \quad [Bq/m^3] \quad (1)$$

Where: C_{Rn} is the radon gas activity concentration (Bq/m³); CPM is the number of counts for the interval; INT is the time interval (min); BG is the background (in cpm) and S is sensitivity (new calibration factor = $1.558 \pm 0.021 \pm 1.32\%$ cpm/(pCi/L) $\pm 4\%$ = 0.0421 cpm/(Bq/m³) $\pm 4\%$). Measurements were made with the passive detector CPRD, without forced air circulation. These measurements were performed on the flat area at 30 cm above the surface. The measurements were performed for ²²²Rn. Fig. 2 shows the average radon concentrations in five measuring location from Turda salt mine, on 20 min interval measurements. The total time measurement in each point was few hours (7-12 h)/ per measurement.

2.2 Gamma spectrometry measurements with HPGe detector

The technique of gamma ray spectrometry was applied to measure the activity concentration of the gamma-emitting

radionuclide in unprocessed salt rock from salt mine ($m = 162.35 \pm 0.06$ g) and soil samples collected from the surface of the salts mine. In the laboratory, the samples were dried, sieved for a grain size lower than $50 \mu\text{m}$ and homogenized. Each sample was stored in standardized polyethylene boxes (Marinelli and cylindrical type). Gamma ray spectrometry measurements were performed using high resolution spectrometer system ORTEC. The system consists of a cooled GEM HPGe detector with a relative efficiency of 30%, of 59.1 mm diameter and 54.1 mm length. The detector has a resolution FWHM (full width at half maximum) of 1.85 keV for the 1332 keV gamma line of ^{60}Co . The system was used for measurements of the emitted gamma rays in the energy range 40 keV - 3000 keV. The measurement time for each sample was 240000 s (live time). Gamma Vision-32 and MAESTRO-32 software (ORTEC) were used to acquire and process gamma-ray spectra. The concentrations of various radionuclides of interest were calculated from the spectra after the subtraction of the background. The activities have been deducted line by line and then an average was calculated. ^{226}Ra concentration was calculated as the weighted average of the activity determined using the gamma-ray lines 295.1 (19.2%) and 351.9 (37.1%) keV gamma-rays from ^{214}Pb , 609.3 (46.1%), 1120.3 (15%) and 1764.5 (15.4%) keV gamma-rays from ^{214}Bi and 186.2 keV (3.59%) the specific gamma-ray of ^{226}Ra . The content of ^{232}Th was determined using the gamma-ray lines 338.4 (12%), 911.2 (29%), 964.6 (5.05%) and 969.0 keV (17%) of ^{228}Ac , 238.6 keV (44.6%) of ^{212}Pb and 583.2 (84.4%) and 860.6 keV for ^{208}Tl [8, 9, 10].

2.3 Gross alpha and beta measurements

Gross alpha and gross beta measurements were performed for the radiological characterization of unprocessed salt rock and soil and for the screening of the samples for relative levels of radioactivity. The salt rock and soil samples were collected from inside of the salt mines and respectively from the access points into the salt mines. About (0.5-0.6) g of each sample was air dried, sieved to remove the stones and pebbles, and homogenized. The measurement of gross alpha and gross beta activity in salt rock and soil samples was taken using a low-background gross alpha-beta counting system MPC 2000 DP (ORTEC). A special device is used to download data acquired and processed by the MPC 2000 (PIC Communicator-Protean Instrument Corporation). The system was calibrated with prepared standard samples that contain known concentration of ^{241}Am for alpha and ^{90}Sr for beta energies. We used a counting geometry <ALPHA + BETA UP> manual count; tray geometry 3 mm below the probe/detector. Counting time was set at 120 min/sample. Each sample was counted for ten times.

2.4 Natural background radiation measurements

Natural background radiation measurements in the Turda salt mines were performed with a Berthold LB 123 meters UMO integrated portable pulse (rate used), equipped with a gamma probe. It was used in counter-timer mode with

integration time of 3600 s/measurement. All calculations were done taking into account the measured natural background radiation.

2.5 Data analysis

The data were processed with Windows Excel software and the errors/deviations were calculated: $S(n-1)$ -experimental standard deviation, $S(n-1)$ (%) -relative experimental standard deviation, $S(\text{med})$ -experimental standard deviation of the mean, $S(\text{med})$ (%) -relative experimental standard deviation of the mean; $S(\text{Poisson})$ -Poisson relative error, uncertainty (global absolute error), etc. $S(\text{Poisson})$ is given for comparison with the value of the standard deviation on the average value, for the purpose of statistical assessment of the average values versus the total number taken [8, 9, 10].

RESULTS AND DISCUSSIONS

3.1. Radon concentration

In the Tables 1, 2 and 3 are reported the mean radon concentrations values measured during 2009–2011 period with PYLON AB5 System. The results of radon concentration measurements carried out for 10 days in different points of salt mine (Cacica, Ocna Dej and Ocna Turda) are presented.

The average concentration of radon in the atmosphere of the Turda salt mine was found to be between 6.9 ± 0.39 Bq/m³ and 12.0 ± 0.75 Bq/m³ depending on the location of the measurement points (Table 1).

In Ocna Turda salt mine, radon concentrations have temporal and spatial variations, the lowest mean radon concentration being recorded at 120 m depth of 6.9 ± 0.39 . The results are function of the location of the measurement points and ventilation conditions, as can be observed for Turda salt mine (Fig.2).

In any situation, inside or outside the Ocna Turda salt mine, with or without ventilation the values of radon concentration are lower than those measured in other salt mine from Romania (ex. Ocna Dej: 12.6 ± 0.79 Bq/m³ [8], or Cacica: 96.5 ± 4.76 Bq/m³).

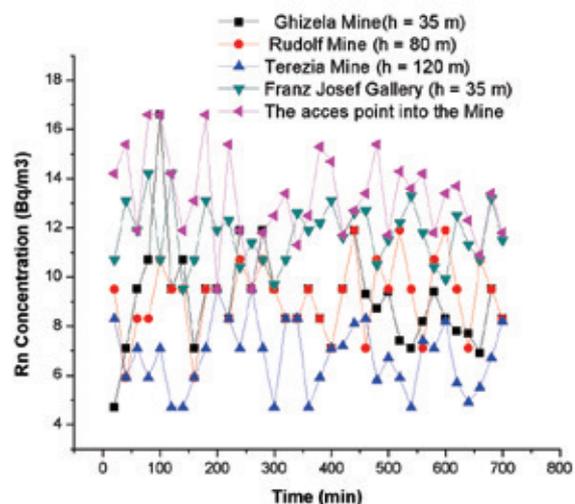


Figure 2. The time dependence of the radon concentration in Ocna Turda salt mine.

Table 1. The average radon concentration in the poorly ventilated enclosed environment from Ocna Turda salt mine.

No.	MEASURING POINT/ LOCATION/ Depth [m]	AVERAGE RADON CONCENTRA-TION [Bq/m ³]	AVERAGE RADON CONCENTRA-TION (With ventilation)[Bq/m ³]	S(n-1) [Bq/m ³]	S(n-1) [%]	S (med) [Bq/m ³]	S (med) [%]	S (Poisson) [%]	Error [Bq/m ³]
1.	Point: #1 Ghizela Mine (Stationary hall) h=35 m	9.5	7.3	2.35	49.40	0.50	10.53	6.15	1.07
2.	Point #2 Rudolf Mine (Surveillance area) h=80 m	9.4	6.8	1.58	16.66	0.23	2.38	4.15	0.44
3.	Point: #3 Terezia Mine (Salt Lake - Pontoon bridge) h=120 m	6.9	4.7	1.52	18.31	0.34	4.09	7.14	0.39
4.	Point: #4 Franz Josef Gallery (the access point gallery) h=35 m	12.00	8.9	1.63	15.23	0.51	4.81	8.42	0.75
5.	Point: #5 Turda salt mine (the access point into the mine as a control location)	13.6	-	2.55	17.88	0.71	4.96	7.05	0.87

Table 2. The average radon concentration in the poorly ventilated enclosed environment from Cacica salt mine .

No.	Ventilation conditions	MEASURING POINT/ LOCATION	AVERAGE RADON CONCENTRA-TION [Bq/m ³]	S(n-1) [Bq/m ³]	S(n-1) [%]	S (med) [Bq/m ³]	S (med) [%]	S (Poisson) [%]	Error [Bq/m ³]
1.	Without ventilation	Salt Lake (swimming pool Point: #1	96.5	17.37	18.00	2.78	2.88	1.73	4.76
2.		Dance hall Point #2	94.9	11.36	11.97	1.84	1.94	1.77	4.22
3.		Gym hall Point: #4	93.8	8.85	9.44	3.61	3.85	4.48	5.21
4.		Access point into the salt mine Point: #6	20.5	2.03	9.90	1.01	4.95	1,85	1.30
5.	With ventilation	Dance hall Point: #3	50.8	9.62	18.94	4.30	8.47	6.54	4.76
6.		Gym hall Point: #4	90.2	10.45	11.58	3.69	4.09	3.95	5.16

Table 3. The mean radon concentration C_{rn} in Ocna Dej salt mine-validation measurements.

No	MEASURING POINT/ LOCATION	Average Radon con- centra-tion [Bq/m ³]	S(n-1) [Bq/m ³]	S(n-1) [%]	S (med) [Bq/m ³]	S (med) [%]	S (Poisson) [%]	Uncertainty [Bq/m ³]
1.	Point #1 Gym - no ventilation	12,6	17,37	18	2,78	2,88	1,73	0.79
2.	Point #2 Gym - with ventilation	9.8	11,36	11,97	1,84	1,94	1,77	1.13
3.	Point #3 Gym entrance	12.2	9,62	18,94	4,30	8,47	6,54	1.80
4.	Point #4 Intersection of 1 mai and Transilvania mines	18.2	8,85	9,44	3,61	3,85	4,48	1.84
5.	Point:#5 Access point into the salt mine	31.7	2,03	9,90	1,01	4,95	10,85	2.76

Table 4. Activity concentrations of radionuclides in salt rock and soil from Ocna Turda salt mine.

SAMPLE RADIONUCLIDES	Salt rock		Soil	
	Activity	Uncertainty	Activity	Uncertainty
	[Bq/kg]			
K-40	<MDA		593.850	16.557
BE-7	<MDA		3.201	1.881
CS-137	<MDA		0.276	0.194
TL-208	4.247	0.369	13.755	0.517
PB-210	<MDA		0.000	0.000
PB-212	<MDA		31.368	0.664
PB-214	<MDA		27.679	0.908
BI-212	18.175	4.924	41.551	4.350
BI-214	<MDA		31.643	1.517
RA-226	13.926	3.831	44.863	4.652
AC-228	<MDA		28.553	1.815
TH-228	<MDA		68.259	16.164
TH-234	<MDA		<MDA	<MDA
U-235	<MDA		<MDA	<MDA
RA-224	<MDA		31.140	3.217
RA-223	3.843	1.146	8.224	0.476
TOTAL ACTIVITY	40.191	10.270	924.362	52.912
232-Th (Thorium series)	28.56	2.31	49.37	14.24
238-U (Uranium series)	13.93	3.83	26.05	3.10
U-235 (Actinium series)	3.84	1.15	8.22	0.48

MDA = Minimum detectable activity.

3.2 Natural gamma ray radiation in salt rocks and soil

The activity concentrations of the different radionuclides identified from spectra collected for the unprocessed salt rock and soil samples from Ocna Turda salt mine are presented in Table 4.

As it can be seen from Table 4, salt rock samples show very low natural activity concentrations. Only traces of the natural radionuclides ^{208}Tl (4.247 ± 0.369 Bq/kg), ^{212}Bi (18.175 ± 4.924 Bq/kg), ^{226}Ra (13.926 ± 3.831 Bq/kg) and ^{223}Ra (3.843 ± 1.146 Bq/kg) were detected in these samples. In soil samples collected from the access point into the salt mine, activity concentrations of these radionuclides (^{208}Tl , ^{212}Bi , ^{226}Ra , ^{223}Ra) are about three times higher than in salt rock samples, but they not exceed the world average activity concentrations noticed in soils [11]. Ten other radionuclides were also found and identified in the soil samples, three of them presenting a higher activity concentration: ^{40}K (593.850 ± 16.557 Bq/kg),

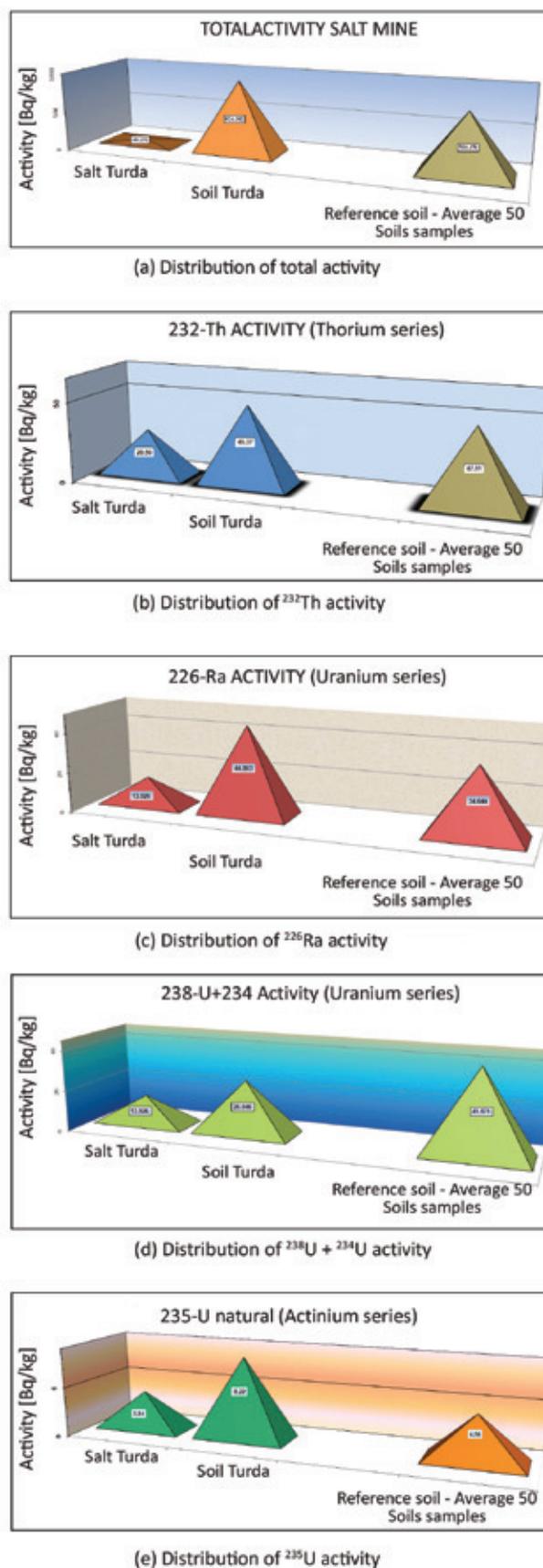


Figure 3. Distribution of radionuclide activity and total activity in salt rock reported at the average activity of radionuclides in 50 soil samples, taken as a reference (a, b, c, d and e).

^{228}Th (68.259 ± 16.164 Bq/kg) and ^{212}Pb (31.368 ± 0.664 Bq/kg). The abundance of ^{40}K activity in soil samples is related to the geological origin of the samples.

Table 4 also illustrates the total activity of the natural radionuclides (^{232}Th , ^{238}U , and ^{235}U) in the salt rock and soil collected at different points of Turda salt mine. The activity of ^{232}Th is observed comparatively higher than that of both ^{238}U and ^{235}U in all salt rock and soil samples. These results are comparable to worldwide average concentration of these radionuclides in soils [11], which are 40 Bq kg^{-1} for ^{232}Th and ^{238}U and 50 Bq kg^{-1} for ^{235}U .

It can see from Figure 3 (a, b, c, d and e) that the radionuclide activity in salt rock from Turda salt mine is much smaller than that of soil samples measured in 50 other locations in Romania (considered as reference), for parents and daughter of the uranium, thorium series. Such low radioactivity concentrations support very strongly the development of speleo-therapy in Ocna Turda mine salt.

3.3. Gross alpha and gross beta measurements

The gross alpha and gross beta measurements are often used as a screening analysis for detecting alpha and beta radioactivity in environmental samples. Important decisions pertaining to use of Turda salt mine as location for the development of speleo-therapy could be based on the results of these analysis. The preliminary results of alpha and beta measurement obtained in the salt rock from Turda salt mine are encouraging (Table 5).

Table 5 shows that gross alpha activity varied between 0.24 Bq/kg and 0.37 Bq/kg with a mean value of 0.31 Bq/kg (Fig. 4a). These values are lower than the alpha minimum detectable activity (0.0176 Bq/sample , respectively 2.88 Bq/kg). It is considered that none alpha emitting radionuclide

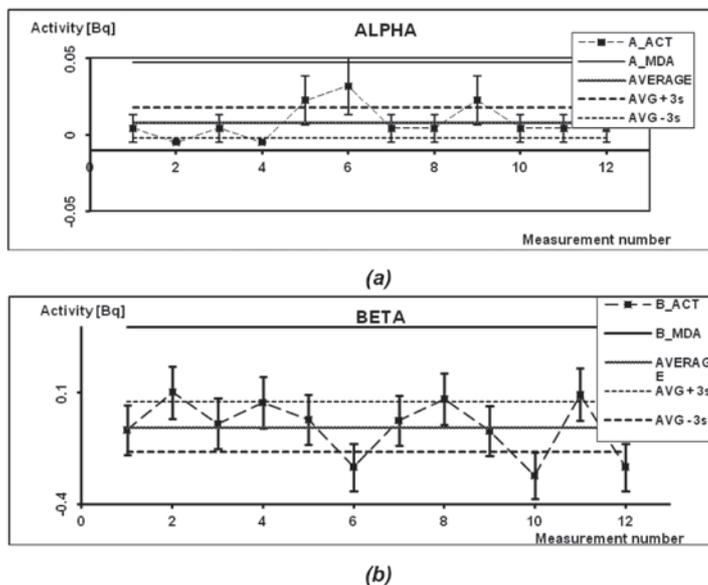


Figure 4. Alpha and beta activity dependence of the number of measurements in the salt rock samples: (a) alpha activity, (b) beta activity.

is detected in the salt rock from Ocna Turda salt mine. The gross beta activity in module ranged from $1.67 \pm 9.15 \text{ Bq/kg}$ up to $18.38 \pm 8.87 \text{ Bq/kg}$ with a mean value of 8.57 Bq/kg (Fig. 4b). The results were below the minimum detectable activity (0.193 Bq/sample , respectively 31.60 Bq/kg) for all samples.

It can be observed that the very low values obtained compared with MDA are due to the difference between natural background radiation and the alpha and beta activity. This difference is sometimes negative because the natural background of radiation has values close or slightly higher than alpha and beta activity of the rock salt samples.

Table 5. Alpha and beta activity in the salt rock from Turda salt mine.

ALPHA						
ID Sample	MASS (kg × 10 ⁻³)	ALPHA ACTIVITY [Bq/kg]	STANDARD DEVIATION ALPHA ACTIVITY [Bq/kg]	MINIMUM DETECTABLE ALPHA ACTIVITY [Bq/kg]	S (n-1) [%]	S (avg) [%]
1.	6.11	0.07	0.53	2.88	139.74	57.05
2.	5.87	0.82	0.07		129.53	55.34
3.	6.07	0.30	0.65		131.27	56.52
4.	6.15	0.07	0.53		133.69	56.86
5.	5.98	0.82	0.07		130.23	55.67
BETA						
ID Sample	MASS (kg × 10 ⁻³)	BETA ACTIVITY [Bq/kg]	STANDARD DEVIATION BETA ACTIVITY [Bq/kg]	MINIMUM DETECTABLE BETA ACTIVITY [Bq/kg]	S (n-1) [%]	S (avg) [%]
1.	6.11	1.67	9.15	31.60	66.36	27.09
2.	5.87	5.85	9.07		63.72	26.65
3.	6.07	18.38	8.87		65.66	26.92
4.	6.15	11.16	9.35		65.84	27.11
5.	5.98	5.79	9.26		64.21	26.81

3.4 Natural background radiation in Turda salt mine

The measurement of the natural background ionizing radiation in the salt mines performed with the portable UMO Berthold LB 123 system revealed the presence of low background radiation inside the mine. Dose rate of background were: $2 \text{ nSv/h} \pm 4.9\%$ (Franz Josef Gallery- the access point gallery, $h = 35 \text{ m}$), $137 \pm 5.34 \text{ nSv/h}$ at the access point into the Turda salt mine, while in the measuring point situated at the greatest depth (Point # 3, $h = 120 \text{ m}$) is only $2 \text{ nSv/h} \pm 7.1\%$. As it was expected, the natural background radiation in Ocna Turda salt mine is tens of times smaller than at the surface of mine.

CONCLUSIONS

Cacica, Ocna Dej and Ocna Turda salt mines' microclimate and low radon concentration levels offers optimal conditions for the implementation of various treatment and prophylaxis therapies of respiratory diseases through gradual and increasing exposure in physiotherapy sessions combined with physical exercises. Exposure to salt mine microclimate has beneficial effects on adult people with occupational risk factors, as well as for children, youth and adolescents for improving the respiratory function. Future development of speleo-therapy and possibly radon therapy in Romania must consider the results of this paper as a potential solution to optimize health services and raising quality of life in Romania.

The use of salt mines and caves is an accepted but not widely known therapeutic measure in the treatment of several respiratory and rheumatic diseases in Romania. It is established that the microclimate of some salt mines and caves can beneficially affect these disorders, but the salt mine environment should be considered as optimal for complex human body rehabilitation. Several clinical investigations both in the world as well as in Romania have confirmed the capacity of speleo-therapy to decrease the microbial contamination of the upper respiratory tract and to inhibit the persistence properties of staphylococcal micro-flora in children with respiratory diseases (asthma, bronchitis, allergies). The benefits of this therapy are known from ancient times and have been proved by numerous clinical studies [12-15]. Also, speleo-therapy curative effects depend on different environmental parameters such as: microclimatic and microbiologic factors, saline aerosols, salt composition, radon concentration, air composition, etc. The low radon concentrations levels recorded in Cacica, Ocna Dej and Ocna

Turda salt mines which have a saline structure, are similar to those found in the literature for salt mine and caves. From the mean radon concentrations found, it is possible to make a first estimate of the effective dose due to inhalation of radon by visitors to the salt mines caves. To quantify the dose, it is necessary to estimate the amount of time spent in the cave by the various risk groups. Presence of little higher radon gas concentrations in Cacica and Ocna Dej salt mines comparable with Ocna Turda can be exploited not only for speleo-therapy but also for future radon therapy use.

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THE XVth INTERNATIONAL SYMPOSIUM OF SPELEOTHERAPY, 2014, WIELICZKA, POLAND

ABSTRACTS

ORAL PRESENTATIONS

Current status, progress and forecasts for development of Polish health resort medicine

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Polish Association of Balneology and Physical Medicine

Balneology and Physical Medicine is the field of medicine that deals with the study and use of specific, natural methods for treatment, prevention and rehabilitation. The principal natural resources used for balneotherapy are: therapeutic waters, gases and peat. The balneology and physical medicine includes: speleotherapy, climate therapy, microbiology, health resort, geology and balneochemistry. Health resort treatment is the key element of therapy of these. Applied treatment methods not only allow improving the quality of patients' lives but conducting health education aimed at promotion of healthy lifestyle, at the same time. Balneology and Physical Medicine is constantly evolving using new methods of treatment and upgrading the old ones. Modern equipment and technologies are no longer a surprise. In forecasting the development of balneology and physical medicine the usefulness and effectiveness of methods for treatment and prevention of chronic diseases should be taken into consideration, in particular. Treatment of epidemic diseases and targeting the treatment, in the thermalism conditions, on the elderly should be the matter of great significance. Balneological methods are helpful in proceedings aiming to slow aging and maintain good physical and mental condition of the elderly. The diseases that have appeared in recent years, being the outcome of civilization progress, should also be taken into account. Furthermore, development of scientific research in the field of Thermal Medicine, including those evidence-based EB(M), is also crucial.

Key words: balneology, balneotherapy, physical medicine

“Wieliczka” salt mine - from water hazard to water treatment

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The biggest natural risk for “Wieliczka” Salt Mine is water. Every time water of low salinity breaks into the mining excavations, the mine is threatened with destruction. Major inflow began to occur in the mine in the first half of the 17th century. The second half of the 19th century brought water calamities to Kloski and Coloredo galleries, almost leading to complete annihilation of the mine. In 1992 the water catastrophe at the Mina gallery forced the management to develop a new strategy for disposal of saline water outflows, used for leaching of rock salt. Simultaneously with implementation of the strategy, efforts were made to obtain the Health Resort status for the mine.

In 2011 the Minister of Health confirmed the possibility of a health resort in the area recognised as a spa treatment center in the underground mining excavations of 'Wieliczka' Salt Mine, Inc.

As part of the development of the health resort, saline waters from the spontaneous outflows known as WVII-16 and WVI-32 were analysed. The research results proved to be eligible for balneotherapy, since they are characterised by specific properties of curative water component - mineralization.

On 30th December, 2013, the National Institute of Public Health – National Department of Hygiene in Poznan, based on the mentioned results, issued certificates confirming the healing properties of water from the spontaneous outflows WVII-16 and WVI-32.

Key words: brine, water hazard

The history of medical treatment in the “Wieliczka” Salt Mine

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The healing properties of salt have been known since ancient times. The oldest records concerning the application of salt from Wieliczka in treatment come from the 16th century. The idea of Wieliczka as a health resort was originated in first half of the 19th century. At that time patients came here to use brine baths. It was Feliks Boczkowski, a mine doctor who initiated the concept of building the baths.

From 1839 to 1855 over 3000 patients were treated in the brine baths. Further development of the baths was interrupted by two World Wars.

Not until 1950s was the baths revived thanks to the initiative of prof. Mieczysław Skulimowski. At that time solid scientific research was done on curing properties of the underground space and how to use them in therapy, which was called later subterraneanotherapy.

Apart from prof. Skulimowski, another pioneers of subterraneanotherapy were: medicine doctor Karl H.Spannagel (Germany), prof. Doctor of medicine Renato Martinetti and med.doctor Alberto Scaturro (Italy). Nevertheless, the subterraneanotherapy had its scientific roots in Wieliczka.

The first underground allergology sanatorium was opened in 1964 which was not only the first in the country but also in the world.

In 1963 the first Society of Underground Climatotherapy was formed here. Prof. Skulimowski provided all the necessary elements to ensure the new therapy, such as: direction, rules, program, method, sanatorium, facilities, equipment, physiotherapists, doctors and well-organized work. This method was, in the following years, enriched with a rehabilitation conducted underground which was unique at that time.

Key words: history of medicine, underground climatotherapy

Promotion of Medical Tourism in “Wieliczka” Salt Mine on International Market

J. Czerwiński

“Wieliczka” Salt Mine Health Resort, Poland

In 2013 “Wieliczka” Salt Mine Health Resort started the project „Promotion of Medical Tourism in Wieliczka Salt Mine on International Market” and obtained funds under the Operational Programme Innovative Economy 2007-2013, co-financed by the European Regional Development Fund. The objective of Sectoral Programme for the Promotion of Medical Tourism Industry is to create new powerful Polish brands, that will be recognized worldwide and therefore, associated with the country of their origin.

The project includes: participation in international conferences and exhibitions, trade missions and study tours, training for the employees, publishing information and promotional materials as well as a study containing the description

of Polish medical tourism industry, prospects of its development, competitive advantages along with comprehensive guide for those wishing to use the services of Polish medical facilities.

Apart from those executed within EU programme, the promotional activities of the Health Resort also comprise collaboration with health tourism organizers and travel agencies, study tours in the Resort, advertising in media industry, Internet marketing and release of promotional materials.

Another important factor of promotional activities is gaining the trust of doctors and patients by cooperating with educational and research institutions, implementing research projects, organising and participating in scientific conferences as well carrying out our medical programme within the guidelines of Evidence Based Medicine (EBM).

Key words: medical services promotion

Turda Salt Mines – potential and perspectives for speleotherapy and balneoclimatic tourism

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Aim: The underground environment from some salt mines can possess various therapeutic properties. In purpose of determining the possibilities for using the Turda Salt Mines for speleotherapy and underground tourism the microclimate parameters were evaluated in different galleries and mines and medical – biological experiments were carried.

Material and methods: Evaluation of physico-chemical and microbiological parameters of underground environment in Turda Salt Mines has been devoted to investigating methods and was used materials and devices specific to type of analysis. The therapeutic quality of this salt underground environment were assessed in two stages, through experimental studies on groups of laboratory animals with induced bronchial asthma, respectively in humans patients. The results were interpreted statistically and were at basis of the elaboration the conclusions.

Results: Following performed investigations have resulted data regarding the temperature, humidity, chemical composition of air, the movement air flow, pressure, air ionization, radioactivity, aerosol concentration in the air in salt mines and galleries and that of microorganisms in underground environment respectively. It was confirmed the beneficial therapeutic effect of the salt mine microclimate on the patients with bronchial asthma and was established methodology of treatment.

Conclusions: Results of performed studies confirm that the old salt mines in Turda can be used for therapeutic and tourism purposes. The investments for the opening a new speleotherapy department in the Salt Mine Joseph from Turda are perfectly justified. Salt Mines Turda is an modern balneo-climatic and tourist objective with specific characteristics that complements of this type network from Europe.

Key words: speleotherapy, tourism, microclimate, salt mines

The possibilities of speleotherapy revival in Sotvino

L. Bosevska

Project supervisor

The emergency environmental situation within the Sotvino rock salt deposit territory has resulted in a loss of functioning salt mines and unique underground speleosanatorium of Ukrainian allergological Hospital (UAH) by flooding. This speleosanatorium was the world's best Speleological Therapeutic center. It has been related to the mine workings of salt mines both spatially and technically.

The major cause of the catastrophic flooding of mines was an absence of knowledge about the features of salt geological environment during the inception of all mines. Accordingly a mistaken strategy of mining operations was adopted.

Over the last three decades, an academic science has made fundamental jump in research area of the salt environmental properties. In conformity with the innovation methodological approaches Ukrainian Salt Research Institute performed special investigations for expert determination and scientific grounding of the possibility to create a new underground department of Ukrainian Allergological Hospital" (2010; project supervisor L. Bosevska).

Taking into account the complex of environmental and geological criteria the promising sites for new speleosanatorium creation were identified in this scientific work. In conformity with complex evaluation the new underground speleosanatorium can be situated within Northwestern part deposit at a depth of 250-300 m (altitude $\pm 0,0$ m). New shafts should make by drilling.

Nowadays the existing powerful innovative theoretical base for the study of salt massifs allows creating a modern and technically advanced model of the safe functioning of different underground facilities within salt massifs.

Key words: possibilities, speleotherapy, revival, Soltovino

The microclimate and natural air ionization in some salt mines – environmental factors with therapeutic potential

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Aim: The paper describes the microclimate and the physical environment (air ionization) of six salt mines in Romania, to assess the speleotherapeutical qualities of the underground conditions.

Material and methods: Measurements were performed by classic and electronic psychrometer for temperature and relative humidity, the aneroid and digital barometer for atmospheric pressure and mechanical anemometers to determine the air speeds. The natural air ion concentrations were measured with a counter Ebert type and an electronic ionometer.

Results: The microclimate is relative cool, 10-15°C the air temperature. The relative humidity is moderate, within the comfort range: 50 to 70%. The anemometric observations indicate air speeds below 0.1 m/s. The barometric regime differs with mine depth, the pressure differences to the surface being $+3.7 \div +22.1$ mmHg. The highest concentrations of ions were more than 1000 ions/cm³ and lower values about 300-500 ions/cm³ (unipolarity coefficient close to unity).

Conclusions: 1. The microclimate is complex and characterized by high stability in time and space. 2. The thermal regime of spaces for speleotherapy is moderately cool. 3. The relative humidity regime is normal, similar to the free atmosphere. 4. The air currents have very low speeds or no air movement. 5. The barometric regime is correlated with variations of free air atmospheric pressure and with analysed depths. 6. The air ionization is differentiated, with concentrations, generally, higher than those of free nature and the electric polarity is close to unity, with favorable role for speleotherapeutical purposes.

Key words: salt mines, microclimate, air ionization, speleotherapy

A 3 year survey of bioaerosol monitoring in salt chambers in the “Wieliczka” Salt Mine

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Aim: The aim of the study was to analyse the qualitative and quantitative composition of bioaerosol in salt chambers of “Wieliczka” Salt Mine Health Resort against a background of the outdoor air.

Material and methods: Until now, the air samples were collected 10 times in 2012-2014 in two salt chambers of the Rehabilitation Centre. Pollen and fungal spore concentrations were measured using the volumetric method. The fungal spores and bacteria colonies were analysed applying microbiological procedures (impact method), while the mite and cat allergens were counted using fluoroimmunoenzymatic assay (FEIA). The results were compared to pollen and fungal spore concentrations in Krakow, measured at the same days by the volumetric method.

Results: Fungal spores, including *Alternaria* and *Cladosporium* dominated in summer, the mean concentration was statistically lower than outdoors. Among bacteria colonies, *Micrococcus*, *Bacillus* and *Coagulacae* negative *Staphylococcus* colonies were found in the higher quantities. No significant differences were found between fungal spore and bacteria concentrations in different study sites, while the clear differences between the particle concentrations in different seasons were observed. The low concentration of pollen grains was noted in the air samples. Concentration of Der p 1 and Fel d 1 allergens in all samples was considerably below the threshold for indoor air.

Conclusions: The low content of microorganisms in the air of salt chambers seems to be related to the biological material carrying in by patients and staff and makes the favourable environment for patients with inhalant allergy.

Key words: bioaerosol, salt chambers, fungal spores, pollen grains, allergens

Speleotherapy and balneotherapy – experimental evaluation

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This article is oriented to develop new strategies of evaluating the functional status of an healthy or pathological organism after speleotherapy and balneotherapy. Our objective was to explore the effects of speleotherapy/balneotherapy on cellular morphology and physiology of pulmonary and dermal fibroblasts obtained from tissues of Wistar rats, in normal and “Ovalbumin” challenged, “asthmatic” conditions, or in wound induced conditions. 60 Wistar rats of 75-100 g weight were divided in three lots: control and “Ovalbumin” challenged and wound animals. Ten animals of each lot were send to Cacica, Turda and Dej Salt Mine for 14 days and maintained in the salt mine medium, as in speleotherapy treatment. Pulmonary and dermal fibroblasts cultures were prepared from Wistar rat lung and respectively dermal tissue. The complex picture of results was analysed and explained through biological mechanisms comparing to the control cell cultures obtained from healthy, untreated Wistar rats. In this article we describe the supposed biological mechanisms that explain the protective effects of speleotherapy. Speleotherapy induces changes on the morphology and protein expression of pulmonary and dermal fibroblasts in vitro, and these changes – by comparing with “Ovalbumin” sensitized animals, supports the beneficial effects of speleotherapy. Comparing speleotherapy with balneotherapy and climatotherapy it is possible to correlate the data and to establish a general strategy of scientific evaluation of the effectiveness of such therapeutic interventions.

Key words: speleotherapy, balneotherapy, health status, wistar, fibroblasts

The effectiveness of subterraneotherapy, a complementary climatic method in the treatment of allergic diseases

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The aim of our last study was to evaluate the influence of subterraneotherapy on inflammatory processes and spirometric parameters in asthma. These investigations were performed in a rehabilitation ward situated 135 meters underground in the salt chamber "Vessel Lake" in Wieliczka. 35 patients with well-controlled bronchial asthma were involved, aged 18-71, of both genders. During a 14-day therapy period, the patients were spending 8 hours in the chamber each day. The severity of airway inflammation was estimated using the concentration of nitric oxide (NO). Spirometry was performed underground on the first and last day. Patients were also asked to answer a standardized symptoms score questionnaire on asthmatic manifestations.

In 26 out of 35 patients there was a significant decrease in the NO concentration, on average by 36.5%, however a week later, the NO elimination recovered to the control values.

In 12 patients there was no change or an increase in NO concentration, but these patients had an additional infection of the upper respiratory tract or required additional betamimetics during the observation period. In 28 patients, a significant increase in inspiratory capacity was seen, on average by 12%, but other static spirometry parameters did not change. However PEF increased in 18 patients, on average by 10.5%. The patients also reported a decrease in the number of dyspnea episodes, and reported that they could breathe deeper.

These results suggest that subterraneotherapy may be a helpful tool in the treatment of bronchial asthma and can diminish inflammatory processes in the airways.

Key words: nitic oxide, inflammation, spirometry, asthma

The speleotherapeutic effect of salt mines underground environment with different curative properties for patients with infection-inflammatory and allergic respiratory diseases

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Introduction: Multidisciplinary environmental studies in speleotherapy sections of different salt mines allow indicates that the environmental values differ, in some cases significantly, due to various geological structures of salt massive, salt chemical component; depth, location, forms and structure of underground sections. Some evaluated salt possesses the potential curative properties, including absence of allergens, extremely low concentration of microorganisms and absence of pathogenic germs; extremely small total radiation, low radon concentration, lack of toxic substances, protecting through salt the layer of surface electromagnetic radiation and climate changes.

Results: In the results of scientific research was found that the therapeutic effect of salt galleries is manifested by positive clinical evolution of chronic respiratory diseases, especially bronchial asthma, chronic bronchitis, infectious-

inflammatory and allergic pathologies of upper respiratory tract, but also of skin. In those patients positive changes occurring of some nonspecific resistance factors of the organism (phagocytosis of PMN neutrophils, macrophages, phagocytes oxidative functions, A, G, M immunoglobulines), inflammatory markers (CRP, some pro- and anti-inflammatory interleukines), the immune status (CD3+, CD4+, CD8+, CD25+, CD19+), sensitization to antigens, immunopathological processes (TTLB with antigens, total and specific IgE, CIC) and functions of adrenal glands.

A special role has the selection of patients according to specific medical indications, as well as method of cure justified and specifies to the therapeutic properties of speleotherapy sections.

Conclusions: This facts justifies the use of speleotherapy in various medical purposes, including, for complementary therapy, rehabilitation, prevention of diseases, health tourism, recreation and sport.

Key words: speleotherapy, salt mines

Medical Rehabilitation induces General Remodeling

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Aim: To define the concept of General Remodeling. To illustrate this concept through an excellent practical model: speleotherapy in a salt mine.

Material and methods: 1. In 2010 I introduced the theoretical concept of General Remodeling through a rehabilitation process and then I searched for a way to quantify the result. 2. The literature reveals phenomena of qualitative elevation, and rebirth, which I refer to as General Remodeling. 3. I took part as a doctor, kinesiotherapist and patient in a speleotherapy prospective clinical study. 4. We combined speleotherapy in a salt mine, empiric psychotherapy, lifestyle improvement, relaxation, complex interactions with medical staff, kinesiotherapists, priests (sacrotherapy), other patients. These polyvalent therapeutic interventions generated General Remodeling.

Results: 1. I utilized specific and complex initial and final evaluation for a group of patients included in a program of speleotherapy in a salt mine for three weeks. 2. All 20 patients, had ameliorated their respiratory impairments, augmented their general endurance, and more, they were so happy that they would like to repeat the experience anytime.

Conclusions: 1. General Remodeling is a profound, holistic and qualitative concept. The medical rehabilitation is one of the possibilities to renew the soul, the mind and the body of the patient. 2. Nowadays evidence-based medicine requires concrete data; thereby I propose a composite index that would help the study of the General Remodeling concept. It includes: a) initial and final evaluation of the patient, b) significant medical parameters, c) life-quality tests, d) profound personality and psychological tests, e) the interview and the self-evaluation of the patient.

Key words: holistic healing process, speleotherapy in salt mine

Complex therapy (climatotherapy, speleotherapy, immunotherapy) in children with chronic respiratory problems

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Children are the most sensitive to environmental contaminants, mostly due to their higher ventilation, immature immune system and, compared to adult population, longer outside stay. Environment pollution effect influences a higher sickness rate, a higher chance of respiratory infections and the rate of allergic diseases including asthma. It is important to

note that indoor contaminations, mostly tobacco smoke, are as effective as outdoor contaminants, for example in children living close to roads with high traffic. Two things are necessary in order to improve clinical manifestation of the medical problems in exposed children: correct diagnosis and transfer of children from high risk areas into medical facilities located in environment with minimal environmental stress. As we tried to gain better information about immune mechanisms taking place in selected population of children treated with speleotherapy and climatotherapy we evaluated a broad spectrum of parameters of specific and nonspecific immunity in two groups of children randomly assigned to groups which were blinded to intervention. Children were 8-14 years old with the same average age in both groups. Subjects were observed on a daily basis by the medical staff and the clinical evaluation and the study evaluation were done by the same medical staff. Our study was directed toward the evaluation of the effects of our complex therapy on some parameters of mucosal immunity, on important parameters of physical performance and improvements of quality of lung functions damaged by contaminated environment.

Key words: speleotherapy, climatotherapy, immunology, children, respiratory diseases

Rehabilitation of patients with chronic respiratory diseases using supplementary methods

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At present, health care remains one of the main functions of the Wieliczka Salt Mine. Indications for rehabilitation and treatment include a range of chronic diseases of the upper and lower respiratory tract. Rehabilitation Centre in Wieliczka treat patients using special therapy to achieve good results. The unique biodynamics of underground air is a result of the activity of temperature, humidity, air pressure, movement and ionization of the air, insulating and protective features of the air, and biodynamic components of the air. (including oxygen, nitrogen, carbon dioxide, sodium chloride aerosol and calcium, magnesium ions). Rehabilitation activities include respiratory and general exercises as well as breath control training and bronchial cleansing procedures; the patients are also educated and have an opportunity to consult specialist physicians. This, combined with inhalation of salt-containing aerosol and stability of climatic circumstances, is expected to result in improvement of the patients' general condition, decrease of the number and severity of exacerbations, and reduced utilisation of emergency medicines, if applicable. Rehabilitation in subterranean conditions may be a valuable supplementary treatment method in patients with chronic respiratory diseases. Patients who do not accept being underground (for example because of claustrophobia) are admitted for individual pulmonary rehabilitation program in base on surface.

Key words: pulmonary rehabilitation, subterraneotherapy

The influence of pulmonary rehabilitation in the “Wieliczka” Salt Mine on asthma control – preliminary results

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Aim: Asthma affects more than 5% of the world's population. According to asthma guidelines the main goal of pulmonary rehabilitation is the optimum asthma control. The Asthma Control Test (ACT) is a standardised five-item questionnaire for the assessment of asthma control.

This study evaluated the influence of subterraneotherapy on the result of asthma control test. The result of asthma control test was compared with other conventional parameters including spirometry, PEF rate (PEFR), fractional exhaled nitric oxide (FeNO).

Material and methods: The study included 21 patients with asthma who underwent 3 weeks lasting pulmonary rehabilitation in the Wieliczka Salt Mine since April 2013 to Juni 2014. The patients completed the ACT questionnaire before and 2 weeks after subterraneotherapy. They underwent testing for FENO PEFr and spirometry (before and 2 weeks after subterraneotherapy).

Results: The mean change in ACT score was 2.38 (SD 2.92). The mean change of ACT in patients with poorly or moderate controlled asthma (N=10) (ACT score <20) was 4.40 (SD 2.86, p=0.042). There was no correlation between change in ACT result and measured parameteres of spirometry and FENO (-0.5<r<0.5).

Conlusions: The pulmonary rehabilitation program improves the quality of life and helps to control asthma in patients suffering from poorly or moderate controlled asthma. The results should be confirmed through the study of bigger group of patients.

Key words: subterraneotherapy, asthma control

25-years experience in the use of non-drug treatment in the SE "Ukrainian Allergic Hospital Ministry of Health of Ukraine"

I. Bakay

"Ukrainian Allergic Hospital Ministry of Health of Ukraine"

Alongside with the main method of Speleotherapy we have been using different non-drug methods of prevention, treatment and rehabilitation of patients with bronchopulmonary diseases, spine disorders and others for 25 years.

The methods we conventionally divide into the following categories:

I. Reflexotherapy: classic acupuncture or acupuncture, microneedletherapy, aurikuloreflexotherapy (ear acupuncture), Su-Jok. Korean acupuncture technique of hands and feet, acupressure, metalotherapy, Tsubo therapy (Japanese method), reflex-segmental massage, Mei-Hua Chen (prick by "plum flower"), polysegmental reflexology, capillarytherapy.

II. Action on BAC electric shock: electrostimulation, electro, electroacupuncture.

III. Laser therapy (effect on BAC using infrared radiation).

We have conducted more than 120 thousand. sessions and treated more than 15 thousands patients for 25 years.

IV. Magnetic therapy.

The method is conducted on the unit for magnetic therapy or magnetophors (magnetoelasts), which are fixed on different tracts of the body.

V. Vakuumentherapie: vacuum massage, "salt jar", "Blood jar".

Vacuum therapy is conducted since 1985. During the year we conduct 1000 manipulations which have anti-edema effect and in used for the preparation of manual therapy.

VI. Effects of temperature factors: jeou therapy, moxa therapy.

VII. Chiropractic.

VIII. Riodorak diagnosis. Conducted by the method of Nakatani.

IX. Aromatherapy.

The combination of all these methods in 90% of cases assist Speleotherapy effect and significantly reduce the number of medications, inhalers and other more expensive treatment, which is proved by laboratory and functional-diagnostic observations.

Key words: non-drug treatment, speleotherapy

A holistic approach to the treatment of allergic diseases. Place of psychotherapy in treatment

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Recent advances in pharmacotherapy and immunomodulation, by themselves, could not prevent the increasing prevalence of asthma.

Taking into consideration the holistic approach, it is analyzed 15 years of experience in the application of methods of psychotherapy in the treatment of patients in the conditions of Regional Allergic Hospital. During this period of treatment and rehabilitation, psychotherapeutic methods were used in 1154 patients.

Our experience confirms that the evolution of asthma is a long process. In the first "act of drama" negative systems of condensed experience are accumulated, which contain not only the accumulated amount of stress factors in the process of personal development (life in an environment where relation to the person as a passive victim prevails, inability to realize their creative potential, the moments of life experience – drowning, chest compressions and other sudden restriction of breathing), as well as transpersonal, morphogenetic element (family tendency to the disease of asthma). At a certain stage of the drama homeostasis (neuro-hormonal and immune) occurs and there is a background for the development of asthmatic complex.

Summing up, it can be noted that the inclusion of psychotherapy in complex of medical and rehabilitation processes (speleotherapy, immunotherapy, pharmacotherapy, physiotherapy) for patients with bronchial asthma has good prospects as a holistic method.

Key words: holistic approach, treatment of allergic diseases

Optimization of immunomodulating effect of speleotherapy with extracorporeal methods of hemocorrection in patients with bronchial asthma

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In the middle of a past century positive influence of speleotherapy is confirmed on a clinical motion of bronchial asthma (BA). The search of medicamental and unmedicamental methods of optimization of immunomodulating effect of speleotherapy lasts.

Extracorporeal methods of hemocorrection such as ultraviolet blood irradiation (EUBI) and plasmapheresis (PPH) are using for patients with bronchial asthma.

Objective: To study the dynamics of immunological indexes in patients with BA after the course of speleotherapy and EUBI, to compare results of immunological indexes after the course of speleotherapy without the sessions of quantum hemotherapy.

Material and methods: There was three groups of BA patients.

Results and discussion: Before treatment was found immunological disorders: depression of neutrophil phagocytosis (FAN), reducing the number of T – lymphocytes, reducing the concentration of immunoglobulins IgA and IgM. At the same time the concentration of immunoglobulins IgE increased to 10-14 times, the level of circulating immune complexes (CIC) increased in comparison with the "normal" values.

After the course of speleotherapy in groups of patients who had PPH and EUBI observed positive dynamics of immunological parameters. Operations of plasmapheresis are effective for moving away of CIC and decline the level of concentration IgE.

The positive effect of using the combination of speleotherapy and extracorporeal methods of hemocorrection is marked to FAN. The number of T – lymphocytes are close to normal in patients who had sessions of EUBI.

Conclusion: 1. The combination of speleotherapy and EUBI is an effective method of immunocorrection in patients with BA. 2. EUBI is recommended for patients with the expressed violation of cellular immunity.

Key words: speleotherapy, hemocorrection, ultraviolet blood irradiation, plasmapheresis, patients with bronchial asthma

The effect of speleotherapy on individual level of humoral immunity in patients with bronchial asthma

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The mechanisms of speleotherapy influence in salt mines and artificial salt mines analogues on individual levels of immunity in patients with asthma have been insufficiently studied. The effect of speleotherapy on one of the main regulatory parts of the immune system - cytokines, and in particular, the interleukins dynamics has not been studied before.

The aim of our study was to examine the dynamics of the main anti-inflammatory interleukins (IL4, IL5, IL10, IL12) in patients with asthma with mild to moderate severity under the influence of treatment in the microclimate of salt mines.

Materials and methods: Under our supervision there were 45 patients who were treated in Ukrainian Allergic Hospital in the period from January to May 2009.

At admission and at the end of treatment patients underwent clinical, biochemical examination of inflammatory activity. During the treatment main clinical symptoms and external respiration function in patients were under control.

The course of treatment made 20±2 days and included 17 sessions of speleotherapy (lasting 5 h) in the salt mine number 8 in Solotvino.

Results: As a result of the treatment in all the patients positive dynamics of the main clinical symptoms and lung function were observed.

The number of eosinophils, total IgE, was significantly decreased. The number of IL4 was also decreased and IL12 was increased.

Dynamics of anti-inflammatory cytokines under the influence of treatment may be one of the mechanisms of general anti-inflammatory effect of speleotherapy in microclimate of salt mines for patients with asthma.

Key words: speleotherapy, humoral immunity, bronchial asthma

30 years of halotherapy

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The concept of "Halocamera" – salt chamber, its technical and medical application as technology - treatment in artificial salt microclimate (Halotherapy) for the first time in the world was introduced by our institution in 1984 (Certificate No 1225569 22.12.1985).

The basic principle of halotherapy lays in the technology of speleotherapy in Solotvino speleotherapeutic hospitals with underground sections in salt mines, especially in the Republican (Ukrainian) Allergological Hospital with Underground Section in Solotvino Salt Mine No 9 (first principal doctor – Pavel Gorbenko).

The first halochamber was constructed in 1985 in the All Union Institute of Pulmonology in Leningrad (Russian Federation) by Pavel Gorbenko – deputy director of science of this Institute. In 1991, the Ministry of Health of the Soviet Union and Department of the Health of Leningrad confirmed the application of halotherapeutic technology for the prophylaxis and treatment of the breathing system diseases and in treatment of allergic diseases at children. According to the statement of the Ministry of Health of Russia halotherapy in Halochamber is conducted according to the medical and technological standards with the use of «Aerogalit». Nowadays more than five thousands of halochambers work successfully in Russia and other countries on the base of this preparation

In 2014, November 13-15, in Sankt-Petersburg the I International (VII National) Congress of Naturotherapy will take place, where halotherapy – Russian innovation technology – will be presented.

Key words: halotherapy, halochamber, microclimate, treatment

Health haloimprovement – new direction of halotherapy

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Aim: Halotherapy is the basic naturotherapeutical technology of prophylaxis, treatment and rehabilitation of respiratory tract, allergic, skin and professional disease, burns of skin, burns of respiratory tract, its combinations and other.

Results: Now this technology have new application for health haloimprovement.

Indications: 1) Medical improvement liquidate of stress, chronic weariness syndrome, syndrome of quantum – energy insufficiency (Russian illness, cold foot syndrome, syndrome of springtime weariness), worsen of general condition, reduce of physical and mental capacity for work, immunity, reproduction function, sleeping, improvement, cosmetology. 2) Prophylaxis of cold disease (respiratory viral infection) and disease of breathing system to peoples with external (who working in influence of harm industry, who live in region with unfavourable ecological conditions) and internal factors of risks, reduction risk development of chronic illness. 3) Naturotherapy (astma bronchiale, bronchitis chronic, pathology of high breathing ways (rhinitis, rhinosinusopathia, pharyngitis), high arterial tension, disease of heart and vessels, osteochondrosis, arthritis, disease with urine stones, mellitus diabetes, disease of gastro-intestinal tract, skin disease and other chronic and recurrence diseases

Private halochember provide effectively prophylaxis illness for all member of family and including the next course of health haloimprovement:

Health haloimprovement – relaxations course; with often 1-3 sessions in the week.

Health haloimprovement – prophylaxis course; often 2-3 course in the year and during and after longtime smoge.

Health haloimprovement – rehabilitation course after accomplish acute period of breathing system diseases.

Health haloimprovement applicate for halorecreation, first and second prophylaxis, fitness, professional sport, pediatric, adults, geriatric and home practice.

Key words: naturotherapy, technology, health, haloimprovement

Haloaerosoltherapy – method of treatment or spa-procedure?

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Speleotherapy today has a solid scientific background and is integrated into conventional therapies and treatments. At the same time, great number of its' artificial analogies are offered for treatment and health improvement in medical establishments, hotels, sanatoriums almost in all countries of Europe. In the majority of cases – it is a business offer, which has no medical component and their effectiveness is just declared.

Analogies of speleotherapy may be divided into two groups – with the presence of haloaerosol environment and without it. "Salt room" without haloaerosol can not be regarded as the true analogy of speleotherapy and its' effect can be evaluated only as relaxing, psychotherapeutic influence.

The main criterion for true artificial analogue of speleotherapy is the presence of rock salt aerosol with the following basic principles:

- Presence of rock salt aerosol generated by a special Halogenerator;
- Aerosol media with certain dispersion and concentration in order to achieve directed influence on the different parts of the respiratory system;
- Controlled parameters of aerosol media during the treatment session;
- Differentiated use of haloaerosoltherapy in various conditions;
- Objective functional criteria for the pathological process dynamics.

This approach provides maximal individuality of different regimes of haloaerosoltherapy. Twenty years experience of haloaerosoltherapy use in conditions of Scientific Medical Centre "Rehabilitation" in the treatment of more than 50 000 patients with bronchopulmonary pathology confirms high efficiency of this approach, not only for the overall assessment of patients, but primarily on the basis of objective set of evidence-based diagnostic methods.

Key words: speleotherapy, rock-salt aerosol, haloaerosoltherapy, salt room

Characteristics of salt aerosols and other factors used in different objects for aerosoltherapy

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The results of hitherto studies conducted in different objects carrying out aerosoltherapy; including graduation towers and underground mining excavations; indicate differentiation of salt aerosol both in terms of the overall concentration of its mineral components and their nature. This is due to many factors, not only technical and environmental, but the type of raw material that forms salt aerosol, as well.

In case of graduation towers the size (height and area) of the object, amount of sunlight, temperature and air motion are of significant importance, whereas in underground chambers salt aerosol and its concentration in air depends on air humidity and ventilation rate of the chambers.

The chemical composition is determined by the type of salt or brine from which the aerosol is formed.

Graduation towers use the natural therapeutic brines (concentration from 6% to >20%), containing, apart from sodium chloride, chlorides of calcium and magnesium, occasionally iodides. The salt in salt excavations is mainly sodium chloride, however calcium and magnesium chlorides have also been found.

Unlike outside, the concentration of mineral components in aerosol and also climatic factors in underground salt excavations are more stable.

The salt concentration in aerosol produced at graduation towers is labile and increases as the brine is concentrated, the content of iodide and (in case of direct sunlight) free iodine are its main characteristic. Therefore, those dissimilarities justify the need for determining individual medical indications for the use of inhaled aerosol, produced in different objects, especially the duration and frequency of such treatments.

Key words: aerosoltherapy, graduation tower, salt excavations, brine

The therapeutic aerosol environment in halo-aerosol treatment rooms of Ukrainian Allergological Hospital

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Therapeutic effect of aerosol therapy largely depends on the parameters of aerosol. The main parameter influencing the therapeutic properties of aerosol is its granule-metric composition. The dynamics of change of the last one largely depends on humidity, but the process of deposition of large dispersed particles is also affected by temperature.

Aerosol environment in halo-aerosol therapy rooms is created by halogenerator through crushing rock salt into the desired dispersion with subsequent submission to the rooms of aerosol therapy.

To register a change of aerosol parameters in real time we developed software and hardware measuring system, which consists of sensors for evaluation of humidity, pressure, temperature and concentration of aerosol.

The technology of aerosol formation in rooms consists of two steps:

- The creation of an aerosol medium in which a rapid increase of salt concentration is obtained by delivering into the room airflow mixed with particles of rock salt;
- Sedimentation of suspended particles, and this is the stage used in treatment technology and is of the greatest interest to study the dynamics of its change.

It's worth to note also the dependence of aerosol concentration in rooms of aerosol therapy on the method of surface treatment facilities. When processing surfaces with brine the concentration of salt increases compared to rooms where the surfaces are untreated with brine.

Thus, the obtained results suggest that artificially obtained rock salt aerosol retains its physical characteristics over time, which is essential to create the given treatment conditions.

Key words: aerosol environment, halo-aerosol treatment rooms

Mechanisms of action and possible therapeutic application of controlled halotherapy

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The present survey reviews the method of halotherapy, simulating some parameters of a microclimate in salt speleohospitals. It presents the data on the development of the method, principles and advantages of halotherapy with the use of manageable microclimate. The mechanisms of action of the main treatment factor - dry sodium chloride salt aerosol, and pathophysiological basics of therapeutic action of halotherapy method are examined. A description of an innovative method of controlled halotherapy is provided and some technical tools for its realization - Halocomplex, equipped with halogenerator ensuring dosing and controlled aerosol are presented.

The survey contains the data on clinical efficacy and a justification for halotherapy application for restorative treatment of patients with bronchopulmonary pathology, ENT pathology, dermatic diseases, concomitant cardiovascular pathology, as well as a method for the prevention of respiratory diseases. The prospects for application of a controlled halotherapy in various medical and healthcare institutions are explained.

Key words: halotherapy, speleotherapy, salt room, halochamber, halocomplex, halogenerator, dry sodium chloride aerosol, respiratory diseases

The state of the business of salt therapy

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Salt Therapy Association

Introduction: This presentation provides an overview of the current and future state of the business side of the salt therapy industry.

Overview: The Salt Therapy Business is significantly growing, especially beyond the origins of the industry in Europe. A few years ago there were just a handful of facilities offering salt therapy throughout the United States, Canada, United Kingdom, Australia, Middle East, India and the Asia markets. Today, there are hundreds of facilities offering salt therapy, whether as a stand-alone salt therapy center or as add-on to an existing business or concept.

In 2011, SpaFinder (the largest independent international spa market research and media company) accurately predicted that Salt Therapy was going to be a Top 5 Growing trend, and while the industry is rapidly growing, it is becoming more known for the valuable benefits salt therapy provides to people, from young to old, as a safe, effective and alternative way of being well.

Description: This presentation will review and highlight the following topics: • Latest business trends of Salt therapy; • Is Salt Therapy a viable business? • SWOT Analysis of the Industry, • Challenges for the Industry, • The Future of Salt Therapy.

Summary: This presentation will provide insight and value for all participants to better understand the economics of the research, health and commercial aspects of the Salt Therapy industry

Key words: halotherapy, industry, business

Effect of cure in “Halotherapy Salon with Salt Mine Artificial Environment” on bronchial asthma patients but other chronic respiratory diseases

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Halotherapy method – descending from speleotherapy, initially consists in artificially recreating of some environmental parameters of salt mines with speleotherapeutic properties. Subsequently, halotherapy has completed by dry salt aerosol in different concentrations and dispersion – haloaerosoltherapy. These methods have the origin from Solotvino (Transcarpathian Region, Ukraine) allergy hospitals with underground sections in salt mines, being afterwards the developed and improved in Uzhgorod Branch of the Odessa Research Institute of Balneology and Physiotherapy – currently Scientific Medical Centre “Rehabilitation” Health Ministry of Ukraine. Later, have been proposed innovations, new improvements and technologies in different countries.

Material and methods: In RDI project / FC 42120/2008-2012 “Complex medico-biological study for the innovative use of the environmental potential therapeutic factors of salt mines and cave in health and balneary-climatic tourism; modeling solutions of these” from Romania RDI-2 Plan, has been created innovative product “Halotherapy Salon with Salt Mine Artificial Environment”.

For experimental halotherapy cure were selected 15 patients with bronchial asthma but other chronic respiratory diseases. Was also investigated of 4 patients with the same pathology to which was applied medical therapy at home.

Results and conclusions: Study indicate the presence of positive clinical effect at 2/3 of patients. Approximately 1/4 of patients gradually reduced dose of specific drugs. Were observed correction of immune pathological changes, the effect of decreasing infectious-inflammatory process and activation of antiinflammatory mechanisms, involving mechanisms and different components of immune system, mineralocorticoid function and adrenal glands. Halotherapy cure including some stages specify to the underground salt mine speleotherapy.

Key words: bronchial asthma, speleotherapy, halotherapy effect

Analysis of reasons aggravating the course of asthma

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In recent years in Ukraine, as well as worldwide, progress has been made in the management of patients with asthma that is shown in reduce of the frequency of exacerbations and mortality. Primarily this is due to the introduction of anti-inflammatory basic treatment into clinical practice, the use of the disease control concept, improvement of the early diagnosis of asthma.

Objective: To identify the main risk factors that aggravate the course of asthma.

Material and methods: The study was conducted in the Regional Allergic Hospital, the main method of treatment is an artificial halo-aerosol therapy. There was 84 patients with asthma of mild to moderate severity. The experience of illness was less than 3 years.

Results: 54% of patients received no adequate therapy theophylline or B2 agonists longlasting; in 4% of patients available nonsteroidal anti-inflammatory intolerance to drugs (including asthmatic triad); 28% of asthma combined with chronic obstructive pulmonary disease; 14% of patients indicated the relationship relapse and progression of asthma with acute respiratory viral infections.

Conclusions: Implementation of educational programs for patients allows to eliminate or significantly reduce effect of factors complicating bronchial asthma; Prevention of seasonal viral infection – an important factor in the removal of exacerbations of asthma.

Key words: asthma, risk factors, artificial halo-aerosol therapy

Gaining control over asthma using nebulizer and artificial aerosoltherapy

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Respiratory diseases are currently the most common in Ukraine, a significant proportion of them is asthma – one of the most difficult medical and social problems. Current approaches to diagnosis, treatment and rehabilitation of this disease make it possible to reduce the severity of the disease, improve functional activity of patients to keep performance.

Objective: – Analysis of the degree of control of asthma in patients who come for treatment; – Analyze the effectiveness of the treatment of mild exacerbations of asthma using nebulizer and artificial aerosoltherapy.

Material and methods: The study was conducted at the SE “Ukrainian Allergic Hospital Ministry of Health of Ukraine”, the main method of treatment which is artificial aerosol. The study involved 76 patients with persistent asthma. The degree of control of the disease evaluated according to the “Asthma Control Test” (ACT).

Results: 21% of the patients partially controlled asthma, 35% of them received only inhaled corticosteroids, and 65% – basic therapy was carried out in inadequate doses; Nebulizer light therapy exacerbations of asthma has several advantages over traditional parenteral therapy.

Conclusions: Use of artificial aerosol therapy can achieve the full degree of asthma control by correcting the basic treatment and improvement of the drainage function of bronchi. Combination of nebulizer and artificial aerosoltherapy provides significant positive clinical effect in the treatment of mild exacerbations of asthma and achieves full control of the disease.

Key words: control, asthma, nebulizer, artificial aerosoltherapy

Hydroelectrolytic balance in rats and humans subjected to halotherapy

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The aim of this study is to determine the effect of halotherapy on hydroelectrolyte balance in human subjects and Wistar white rats with induced pathology.

The study was performed on 20 adult Wistar white rats sensitized with ovalbumine and 18 human subjects divided in experimental and control groups.

The rats and humans from experimental groups were subjected to a period of halotherapy for 21 days.

In order to study the electrolyte balance animals were kept for 24 hours in individual metabolic cages without food and with free access to a saline solution. After 24 hours was measured water volume (ml/24 h), the amount of sodium intake (mEq/24 h) and urine volume (ml/24 h).

For the human subjects the urine was collected in various days of experimental halotherapy.

The concentrations of sodium and potassium in urine (mEq/24 h) was assayed using a Ciba Corning 480 flame photometer.

From these values were calculated the urinary Na/K ratio as an expression of the mineralocorticoid response of adrenals in the experimental conditions.

On sensitized Wistar white rats was observed that the halotherapy normalize the most parameters of the hydroelectrolytic balance.

In human subjects the adaptation process to halotherapy conditions begin after 8 to 10 days of exposure, the regulator function of adrenals being adapted to the increased salt loading of the body.

Key words: halotherapy, sensitized rats, mineralocorticoid activity

The effectiveness of halo-aerosol therapy in children with obstructive bronchitis treated in the SE "Ukrainian Allergological Hospital" Ministry of Health

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Aim: To study the effectiveness of the treatment of children by halo-aerosol therapy in addition to clinic laboratory researches and respiratory function parameters testing, a special questionnaire to study treatment efficacy after repeated courses of treatment was worked out.

Material and methods: All patients had a course of halo-aerosol therapy in an amount of 15-17 sessions lasting up to 1 hour in January-May 2013.

Also we have studied the dynamics of medications to relieve attacks of choking, the number and frequency of outpatient and inpatient treatment during the year after halo-aerosol therapy.

We have studied 22 questionnaires of children aged 3 to 14 years who were in re-treatment. Results:

20 patients (90.9%) noted significant improvement after the first course of halo-aerosol therapy. Remission for more than 6 months occurred in 10 patients (45.5%). The main cause of repeated exacerbations of the disease in 54.5% were acute respiratory infections.

After the first course of halo-aerosol therapy cough decreased in 8 children (36.4%), bronchial hypersensitivity decreased in 16 (72.7%), the use of medication tablets and injection decreased in 14 (63.6%), taking hormones decreased in 5 of 5 patients (100%). Number of outpatient treatment during the year decreased in 10 children (45.5%) and hospital treatment needed only 5 children (22.7%).

Conclusions: Thus, according to the research on the effectiveness of treatment by halo-aerosol therapy in children with obstructive bronchitis it is pointed out high efficiency of treatment which is generally higher than in patients with bronchial asthma.

Key words: halo-aerosol therapy, children obstructive bronchitis treated

The effectiveness of halo-aerosol therapy in adult patients with asthma

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We studied the efficacy of treatment by halo-aerosol therapy in 80 adult patients treated in 2012-2014 in the hospital, including 50 women and 30 men aged from 30 to 60 years with asthma (BA) with heavy and medium severity of the disease.

To study the effectiveness of the treatment by halo-aerosol therapy in addition to clinical laboratory researches and respiratory function parameters testing, a special questionnaire has been developed in the hospital. In the questionnaire patients evaluated the effectiveness after the first and second courses of treatment, remission after each course of treatment, the effect of halo-aerosol therapy on the dynamics of the main symptoms (nasal congestion, the number and nature of the attacks of asthma, signs of bronchial hyperreactivity).

Patients took a course of halo-aerosol therapy in an amount of 17-18 sessions. The second course was conducted a year later.

After the first course of treatment 56.2% of patients noted improvement of the disease, in 31.3% of them the remission lasted for 3-6 months. At the same time 12.5% of patients noted no improvement.

After the second course of halo-aerosol therapy 81.3% of patients noted remission for one year and the lack of effect was noted only in 8% of patients.

After re-treatment in 68.7% of patients the number of outpatient treatment courses was reduced and in 83.3% of patients the number of in-patient treatment courses decreased.

Thus, halo-aerosol therapy has a very high efficiency in treating patients with asthma, and repeated courses enhance the effectiveness of treatment.

Key words: effectiveness, halo-aerosol therapy

Effectiveness of halo-aerosoltherapy on the indices of lipids peroxidation and antioxidant protection at patients with community acquired pneumonia

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The purpose of our research is to study the influence of complex halo-aerosoltherapy on lipids peroxidation and antioxidant defence processes at patients with community acquired pneumonia on the early convalescence period. Overall 42 patients were examined.

It was found that the early period of convalescence was characterized by metabolic disturbances with high activity of pro-oxidative processes on the background of low activity of the main antioxidant defence enzymes – superoxide-dismutase and catalase. These changes indicated presence of a residual inflammation in the organism and destructive effects of free radicals on the membranes of bronchial tree.

By the end of halo-aerosoltherapy according to the medical complex, which included a 60 minute-long everyday haloaerosoltherapy sessions, residual metabolic disturbances of different levels were present. Despite the normalization of the main parameters that reflect the level of peroxidation processes, the activity of superoxide dismutase and catalase in erythrocytes was still significantly lower than in healthy.

On the other hand, halo-aerosoltherapy with high hyperosmolar influence of two daily 30-minute sessions results in the equalization of the oxidant-antioxidant balance compared with the previous group. These positive changes were received due to preserving the normal values of lipids peroxidation primary products, normalization of secondary and final products and significant increase in superoxide dismutase ($p < 0.05$) and catalase activity ($p < 0.02$).

Thus halo-erosoltherapy can be considered as a method of pathogenetic therapy for patients with community acquired pneumonia which slows the process of lipids peroxidation, increases the activity of antioxidant defence, especially using medical complex with higher hyperosmolar influence.

Key words: halo-aerosoltherapy, community acquired pneumonia, lipids peroxidation, antioxidant defence

Halo-aerosol therapy at related ENT pathology in adults with bronchial asthma

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Allergic diseases of the upper respiratory tract (rhinitis, sinusitis) play a significant role in the pathogenesis and development of bronchial asthma.

We have studied the effectiveness of halo-aerosol therapy in 80 adults who were treated in the hospital in 2013-2014. Among them there were 50 women and 30 men at the age from 30 to 60 suffering in bronchial asthma with moderate and severe form of the disease.

The patients were undergone a course of halo-aerosol therapy, which included 17-18 sessions with repeated treatment in a year.

Different ENT pathology was diagnosed in 68.7% of patients including allergic rhinitis in 63,3% and the inflammation of maxillary sinuses in 36.7% of patients. A significant improvement of ENT pathology with allergic rhinitis was noted as a result of treatment in 56.3% of patients. Much less effectiveness was noted in patients with the inflammation of maxillary sinuses (18.2%).

We have also studied the dynamics of prescribed medications to relieve attacks of choking, the number and frequency of outpatient and inpatient treatment during the year after halo-aerosol therapy.

The repeated course of halo-aerosol therapy extended the duration of remission up to 1 year in 72.5% of patients with allergic rhinitis and in 21.25% of patients with chronic sinusitis.

Thus, halo-aerosol therapy has a significant influence on the duration of related ENT pathology in bronchial asthma patients.

Key words: halo-aerosol therapy, ENT-pathology, bronchial asthma

Effect of halo-aerosol therapy on related otolaryngology pathology in children with obstructive bronchitis and asthma in the "Ukrainian Allergologic Hospital"

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We have studied the influence of halo-aerosol therapy for related otolaryngology pathology in children with obstructive bronchitis and bronchial asthma treated in 2013 by the method of questioning.

In the questionnaire parents of the children assessed the effectiveness of treatment, remission, influence of halo-aerosol therapy on the dynamics of the main symptoms of the disease (nasal congestion, runny nose, number and nature of attacks of breathlessness, signs of bronchial hyperreactivity, presence and nature of cough).

We have worked out 50 questionnaires for children aged 3 to 14 years who were in re-treatment. Associated otolaryngology pathology was noted overall in 42 children (84%), among them 21 children with asthma (75%) and 18 children (81.8%) with obstructive bronchitis.

All patients were undergone a course of halo-aerosol therapy, which included 15-17 sessions, each of which lasting up to 1 hour in January-May 2013.

Also we have studied the dynamics of necessary medications to relieve attacks of choking, the number and frequency of outpatient and inpatient treatment during a year after halo-aerosol therapy.

As a result of treatment the main symptoms of otolaryngology pathology (nasal congestion, runny nose, itchy nose) decreased in 24 patients (57.1%), among them 14 children with asthma (66.6%) and 14 children with obstructive bronchitis (77.8%).

Thus, the effect of halo-aerosol therapy on related otolaryngology pathology is greater in children with obstructive bronchitis than with asthma.

Key words: halo-aerosol therapy otolaryngology pathology

Comparative characteristics of the efficiency of treatment of asthma by speleotherapy and halo-aerosol therapy

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SE "Ukrainian Allergological Hospital" Ministry of Health of Ukraine

Under our supervision there were 103 patients. They were divided into two groups: to the group I there belonged 45 patients who were treated by speleotherapy method in Ukrainian Allergic Hospital. To the group II there belonged 58 patients treated who were treated in artificial microclimate rooms in Ukrainian Allergological Hospital in 2010-2011. Of a total of 103 patients examined, there were 39 men (38.6%) and 64 women (63.3%).

Comparing the dynamics of clinical symptoms in the two groups, it should be noted the best positive effect in the first group of patients who were under the treatment by the method of Speleotherapy in the salt mine №8, in contrast to the second group, who were treated in artificial microclimate.

As can be seen from these data under the influence of treatment in both groups it was observed a significant decrease of IgE and more pronounced in the group I.

Also, we have seen a significant decrease of IL4 and increase of IL 12 under the influence of Speleotherapy in the given patients.

Thus, applying the method of Speleotherapy in a microclimate of salt mines and halo-aerosol therapy in the rooms of artificial microclimate we found a pronounced effect of treatment on clinical symptoms, general clinical indexes, the immune system and respiratory function in patients with asthma, indicating a high therapeutic efficacy of the method of Speleotherapy and artificial halo-aerosol therapy in the treatment and rehabilitation of patients with BA.

Key words: speleotherapy, halo-aerosol therapy

Concerning some aspects of vision in the field of speleotherapy and halotherapy

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Background: In the past 10 years a number of publications have appeared in the speleotherapy and halotherapy field, leading to misunderstanding of the speleotherapy history and status, as well as halotherapy – descending method of speleotherapy in salt mines. It is often mistakenly given speleotherapeutic effect, medical indications and contraindications often have no scientific justification being to the same treatment in the underground environment of salt mines or karst caves, which actually is different in most cases not only between salt mines or other origin mines but also between caves and spaces for halotherapy.

Results: Analysis of activities in speleotherapy and halotherapy allow to justify the need to promote of some constants principles in the field, including:

Classification of salt mines or other origin mines, and of the caves used or usable for speleotherapy, balneoclimatic of health tourism and speleological or mining tourism.

Achieving or improving norms of use the underground spaces from mines and caves with different curative properties proposed for the speleotherapy, norms for artificial spaces for halotherapy also for the intact preservation of curative properties.

Launch of multidisciplinary scientific research projects in national and international programs with state and private funding.

Conclusions: Thus, three clusters will be formed for the development of the partnership:

Cluster for Speleotherapy and descending methods in Medicine;

Innovative Partnership on Healthy Speleotherapy and of descending methods;

Cluster for Health Speleotherapeutical Tourism and Recreation in salt mines, other mines and caves with curative properties, for halotherapy and other descending methods

Key words: speleotherapy, halotherapy, history, cluster

Halotherapy in prophylaxis, therapy and rehabilitation (Proposal for international clinical recommendation)

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International clinical recommendations for halotherapy are proposed, which will indicate the conditions for halotherapy, requirements to halotherapy rooms and materials used in construction, necessity for specialized medical personnel training, indications and contraindications.

Key words: halotherapy, prophylaxis, treatment, rehabilitation

POSTERS

Radiometric measurements and evaluation of Radon concentration in some Northern Romanian salt mines for speleotherapeutical, medical purposes and balneary tourism

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The knowledge of radon concentration levels in underground environments is essential for therapeutic purposes of different respiratory and rheumatic diseases. In order to develop speleotherapy in Romania, this paper presents the results of an indoor radon concentration levels survey in some salt mines in Romania.

The survey was carried out using radon monitor Pylon system methodology. In order to investigate whether differences in depth and microclimate parameters translate into significant differences in salt mine indoor radon concentrations, have been chosen three salts mine test sites placed in the Northern part of Romania (Cacica [1, 2, 5], Ocna Dej [3, 5] and Ocna Turda [4, 5]) in stable areas of the mining field at 32-120 m depth.

Environmental microclimate conditions (mean values of air temperature 10–14.5 °C, air humidity 65-80%, air velocity 0.2 m/s saline aerosols and low microbial factors) have anti-bacterial, anti-microbial, and anti-inflammatory properties and recognized therapeutically effects on human body's health.

The measuring of the natural background ionizing radiation in salt mines was made using the Berthold Umo LB portable integrated impulse debit meter (used in rate mode) equipped with a gamma probe – Counter-timer and at an integration times of 3600 s/measure. The measurement and calibration procedures were conducted in conformity with the procedures of the accredited (SR EN ISO/CEI 17025: 2005) SALMROM laboratory.

The analyzed environmental conditions and recorded low levels of indoor mean radon concentration $6.9 \pm 0.39 \text{ Bq/m}^3$ demonstrated the best suitability of the investigated three salt mines in Romania for speleotherapeutic applications.

Key words: radon, salt mine, radiometric methods, radiometric characterization, therapy, speleotherapy

Effect of salinity gradient on biodiversity of phytoplankton in different therapeutically saline lakes from Romania

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From all the mineral lakes in Romania, the biggest therapeutic importance goes indisputably to the lakes with salted water because on the substrate of these lakes there are formed grand deposits of therapeutic mood.

Aim: It has been identified and compared the phytoplankton composition from six salt lakes existing in Romania, with a different salinity.

Material and methods: For each phytoplankton sample, 100 liters of lake water have been filtered through the plankton net, 25 μ mesh, from the epilimnion (30-50 cm depth). The concentrated samples were preserved immediately with Lugol solution and then labeled. The phytoplankton samples were analyzed in a Fuchs-Rosenthal chamber; for accuracy, three duplicate counting were made in chamber (both the upper and the lower chamber) for each sample of phytoplankton.

Results: 1. The highest number of phytoplankton species was recorded in Techirghiol Lake (127 species) and the lowest number in Black Lake-Sovata and Salt Lake Brăila (23 species). 2. For Cyanobacteria and Bacillariophyceae, the calculated values for the Sorensen similarity coefficient reflect a weak association of the species in the salt lakes; for the Euglenophyceae,

Chrysophyceae, Crysophyceae, Dinophyceae, Xanthophyceae classes the comparison of the species diversity was impossible because they were not found in all studied biotopes. 3. The composition of the Chlorophyceae class was similar in the plankton of two clusters: cluster 1 – Techirghiol Lake and Black Lake-Sovata; cluster 2 – Salt Lake- Brăila, Fundata Lake.

Key words: phytoplankton, lake, salinity, therapeutic

Use of laboratory animals in medical-biological experiments on the effect of different environmental therapeutic factors of salt mines

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The laboratory animals used in research in many scientific domains, but especially in biology, medicine and veterinary medicine. The most used laboratory animals are now rats (Wistar rats) because they share about 99% of human DNA and also have opportunity to research, investigate various pathologies and of its evolution in a way that otherwise would affect a human patient. The experimental protocols include the step in which animals are euthanized, either to remove organs and tissues or not subjected to unnecessary pain and suffering the animals (humane endpoints), or to mark the end of the experiment. Euthanasia techniques result in the rapid loss of consciousness followed by cardiac arrest, respiratory arrest and cessation of brain function. Indifferent of the method used to respect the deontological principles of veterinary medicine.

In the National Institute of Rehabilitation, Physical Medicine and Balneoclimatology, Bucharest, where research is conducted, different patterns have been obtained pathologies to la Wistar Rats.

Laboratory animals that were subsequently subjected to the action of various therapeutic factors biological, physical and natural therapeutic, including the underground salt mines in Romania of and is realized and complex multidisciplinary medicobiological studies which enabled to evaluate some adaptation mechanisms and positive changes in systemic, cellular, molecular, and organismic processes in different periods of treatment in the some salt mines and experimental spaces for halotherapy, which enabled to highlight the therapeutic effect and to obtain experimental data usable for later studies of patients with mentioned pathologies, achieving medical indications and contraindications and methodologies cure.

Key words: wistar rats, salt mines, speleotherapy, halotherapy

Evaluation of rehabilitation complex “Wieliczka” salt mine effectiveness in patients with bronchial asthma

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Nowadays patients from Lviv Region (Ukraine) have a great opportunity of treatment in “Wieliczka” salt mine (Poland). We are grateful for this chance and present our data.

The aim of our study was to evaluate the effectiveness of rehabilitation complex “Wieliczka” salt mine in patients with bronchial asthma (BA).

Material and methods: medical records of 12 patients with BA (4 boys, 5 girls and 3 adults) receiving rehabilitation complex “Wieliczka” salt mine during the period from 2009 to 2014 were analyzed. In 5 patients was diagnosed mild and in 7 moderate persistent BA. The patients received rehabilitation treatment in “Wieliczka” salt mine during the remission of the disease: 4 patients received one course, 5 – two and 3 – three courses of rehabilitation complex.

Results: Patients who received three courses of rehabilitation complex in “Wieliczka” salt mine had the best results: during the last 2 years was diagnosed BA remission in all of them. In 3 (60%) who received two courses of rehabilitation

complex had more than one year remission and in 2 (40%) – exacerbation of the disease occurred with less frequency and duration. Among patients who received one course of treatment, in 2 (50%) the disease was almost unchanged and in the rest we observed a tendency to shortening of the frequency and duration of BA exacerbation. The effectiveness of treatment was higher in children rather than adults.

Conclusions: 1. Rehabilitation in "Wieliczka" salt mine leads to decrease the frequency and duration of BA exacerbation. 2. Repeated rehabilitation courses allow to achieve long remissions in patients with mild and moderate persistent BA.

Key words Speleotherapy, respiratory disease prevention, allergy, children, adults

Some results and late clinical outcomes after speleotherapy in Cacica salt mine, Suceava, Romania

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Aim: To analyze the clinical results during speleotherapy in the salt mine and the three-year longitudinal follow-up of patients after cure.

Material and methods: Prospective, directly observed study. Twenty patients with mild/medium chronic respiratory diseases descended 3 weeks in the Cacica salt mine.

Results: In the initial 3-5 days the cough was stimulated at 3 patients with chronic bronchitis and the hyperosmia was exacerbated at 2 patients with allergic rhinitis. The preexisting inspiratory and expiratory wheezing – 1 case and expiratory wheezing – another – were remitted after 2 days of speleotherapy. After 8 days, the patients achieved a respiratory comfort, expression of a progressive adaptation: the respiratory hypersensitivity diminished, only rare cough persisted, with difficult sputum elimination. The effort dyspnea decreased and the 63 meters by stairs were easily climbed to the exit from the salt mine. The quality of sleep was ameliorated. After 10-15 days, approximately 2/3 of the patients presented improved general health with better effort endurance, without coughing, wheezing or adverse reactions. At 2 patients with COPD the productive cough became very rare. Some patients with chronic treatment progressively gave it up after 6 sessions (4 patients) and after 10, respectively 12 sessions - 1 patient. The 3-year follow-up revealed the persistence of the amelioration during 3-36 (mean 15) months.

Conclusions: After 3 weeks of experimental cure in salt mine of Cacica, the patients had adapted at the subterranean climate, the symptomatology decreased or disappeared, the effort endurance improved, and there were no adverse effects.

Key words: chronic respiratory diseases, follow-up

The impact of the additional speleotherapy in children with cystic fibrosis

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Introduction: Cystic fibrosis is the most common genetic disorder in caucasians, autosomal recessive inherited, affecting approximately 1/2500 of newborns. Incidence of the disease requires, besides specific diagnostic and treatment strategies, quantifying and improving the quality of life of these patients.

The aim and motivation of the study: The idea of the study emerged from the fact that the children who have a severe evolution and an unfavorable response to treatment, difficulty or lack of cooperation in the administration of the therapy, have also a poor quality of life. Given the benefits of the speleotherapy in chronic lung diseases, and the development of medical tourism in our country, the impact of this is worth investigating through extensive research.

Materials and methods: The study included a group of 28 young patients diagnosed with cystic fibrosis in 2nd Clinic of Pediatrics at the Emergency Hospital for Children "Sf. Maria" in Iasi, Romania, following the subjective evolution of the child's health (from the perspective of the family) and the objective outcome (by clinical, biological and spirometric assessment) after 2 courses of speleotherapy (associated with dornase alfa-the background therapy) and their comparison with data from current studies.

Results and discussion: In children with cystic fibrosis who receive background dornase alfa treatment, additional speleotherapy improved personal perception on quality of life, and the evolution of respiratory damage, by decreasing the frequency and severity of infectious exacerbations.

Key words: cystic fibrosis, child, speleotherapy, evolution, quality of life

New serum biomarkers for oxidative stress useful in bronchial asthma and salt mine speleotherapy treatment monitoring

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Bronchial asthma is a pulmonary disorder characterized by reversible obstruction of air flow, hypersensitivity of airway, chronic inflammation, generation of inflammatory mediators and epithelial cells exfoliation. Worldwide, asthma incidence increase with 50% for each decade and the most used classical biomarkers in patient monitoring are IgE, antibodies involved in allergic diseases. The aim of this study is to relieve new serum biochemical markers helpful to monitor the asthmatic patients and to compare the experimental parameters values obtained from patients who took only medicines and patients who used an alternative therapy (speleotherapy) besides medicines.

In this study we used 10 healthy patients (control group), 5 untreated asthmatic patients and 5 asthmatic patients treated by speleotherapy in Turda salt mine to analyze a parameters with a potential role of serum biochemical markers in bronchial asthma like MDA, carbonyl and thiol groups, total sialic acid, oxidized LDL and sialic acid from oxidized LDL.

Our data shows that pathological processes involved in asthma imply an increased enzymatic activity of xanthine oxidase (28%), which correlates with increased levels of MDA (87.2%), total sialic acid (30%), carbonyl groups (80%) and decreased levels of thiol groups (37%), oxidized LDL (29.6%) and sialic acid conjugated with oxidized LDL (45.5%); after speleotherapy all values have tended to be normalized.

Based on this results we consider that our studied parameters can be successfully used in detection of bronchial asthma and monitoring the speleotherapeutical treatments in asthmatic patients.

Key words: asthma, speleotherapy, oxidative stress, serum biochemical markers