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[Intervention Review]

Speleotherapy for asthma

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ABSTRACT

Background

Speleotherapy, the use of subterranean environments, is a therapeutic measure in the treatment of chronic obstructive airways diseases. It is virtually unknown in the UK or the US, but has considerable widespread use in some Central and Eastern European countries.

Objectives

To review evidence for the efficacy of speleotherapy in the treatment of asthma.

Search methods

We searched electronic databases (MEDLINE, EMBASE, Cochrane Airways Specialised Register), contacted speleotherapy centres and experts in the field, handsearched proceedings, and checked bibliographies of articles obtained to identify possible relevant publications. The most recent search was in April 2006.

Selection criteria

We included controlled clinical trials (i.e., both randomized and those not reporting the method of allocation) that compared clinical effects of speleotherapy with another intervention or no intervention in patients with chronic asthma.

Data collection and analysis

Information concerning patients, interventions, results, and methodology were extracted in standardized manner by two independent reviewers and summarized descriptively.

Main results

Three trials including a total of 124 asthmatic children met the inclusion criteria, but only one trial had reasonable methodological quality. Two trials reported that speleotherapy had a beneficial short-term effect on lung function. Other outcomes could not be assessed in a reliable manner.

Authors' conclusions

Due to the paucity of trials, the available evidence does not permit a reliable conclusion as to whether speleo-therapeutic interventions are effective for the treatment of chronic asthma. Randomized controlled trials with long-term follow-up are necessary

PLAIN LANGUAGE SUMMARY

Speleotherapy (exposure to salt air, usually underground) for asthma

Speleotherapy (staying in underground environments) is believed to be of some benefit to people with asthma. People spend short periods in specifically designated caves or mines, sometimes doing particular physical or breathing exercises. There are some wards for longer stays. Benefits are believed to come from air quality, underground climate, air pressure or radiation. These features differ among caves and mines (for example, there are high levels of radiation in some mines, and different types of humidity). No evidence from randomised controlled trials was found and more research is needed.

BACKGROUND

Speleotherapy, the use of subterranean environments, is a therapeutic measure in the treatment of chronic obstructive airways diseases. It is virtually unknown in the UK or the US, but has considerable widespread use in some Central and Eastern European countries.

The main curative factors of speleotherapy in caves and mines are thought to be air quality, underground climate and radiation. Two main kinds of air quality can be distinguished - firstly in salt and potash mines and caves, and secondly in karst caves and ore mines. Three forms of climate can be recognised (by temperature) - cold, moderate, warm and three forms of climate (by relative humidity) - low, normal, high and three forms of climate (by pressure) - low, normal, high. There are four forms of radiation - high level due to radon, moderate level - to potassium-40, normal level - to normal karst rock, and low level - to common salt rock (halite).

In practice there are: (1) cold and moderate karst caves with high humidity, normal pressure and normal radiation level (e.g., Slovak caves); (2) warm karst or granite bedrock caves with high humidity, normal pressure and high radiation level due to radon (e.g. Gasteiner Heilstollen, Badgastein-Bockstein, Austria); (3) potash mines with moderate temperature, normal humidity, high pressure and moderate radiation level (e.g. Berezniki, Russia; Soligorsk, Byelorussia); (4) warm salt mines with low humidity, high pressure and low radiation level (e.g., Solotivo, Ukraine; Tîrgu Ocna, Romania; Wieliczka, Poland); (5) salt mines and caves with moderate temperature, low humidity, low pressure and low radiation level (e.g. Chon-Tus, Kirgizia) and others.

In cold caves (temperature 6 - 10 degrees C., relative humidity 80 - 100%) the patients stay daily for about one hour during a three or four week sojourn at the health resort. In most caves, patients are advised to rest during this period. In some caves physical exercises or breathing exercises, including salt aerosols, are recommended.

The caves and mines with a moderate temperature (13 - 20 degrees C., relative humidity 45 - 70%) are used for longer treatment periods (e.g. about 8 to 10 hours 3 to 4 times per week). In Eastern European countries even some kinds of ward have been built in these caves, or mines, to allow the patients to stay in this climate for a longer period of time.

Warm caves (and former mines) (30 - 41 degrees C., relative humidity 70 - 100%) are used for treatment in Italy, France and Austria. In most of these warm caves there is an elevated concentration of radon, which is considered an important component in this form a climatic therapy. Patients stay in these caves for about one hour. Sojourn of three or four weeks at the health resort with entries every day or every other day are recommended.

Several components of the subterranean environment, air quality and climate in the caves and mines have been thought to be relevant in the treatment of asthma. These include:

- absence of normal biotic conditions (e.g. light)
- temperature difference underground and on the Earth surface
- natural (but higher than normal) radiation level
- low mobility of air (<0.1 m/s) and big volume of underground atmosphere and large surface of its interaction with the

surrounding area - presence of mineral water drops or hygroscopic minerals' aerosol

- presence of moderate or high relative humidity for the constant process of condensation and as a result contributing to the pureness of the air, scavenging dust, pollen and gases
- high rate of air ionisation (by radon or potassium-40)
- low levels of dust (0.05 mg/m³), pollen (<30/m³) and gas pollutant concentration (low level of irritation)
- low levels of bacteria and other bioaerosols contamination
- constancy of the climate
- presence of finest aerosols of vital elements (Na, K, Mg, Ca and so on)

In cold caves, the high relative humidity contributes to the purity of the air.

OBJECTIVES

The objective of the review was to investigate the evidence for the effectiveness of speleotherapy interventions in the treatment of asthma.

The review was planned to address the following questions:

- Compared to control interventions, does speleotherapy have a positive effect on physiological outcomes, such as peak expiratory flow rates (PEFR), forced expiratory volume (FEV₁) or vital capacity in asthmatic patients?
- Compared to control interventions, does speleotherapy, have a positive influence on quality of life, subjective symptoms, medication use, immunological state, morbidity, and mortality in asthmatic patients?

METHODS

Criteria for considering studies for this review

Types of studies

Controlled clinical trials (randomized trials and trials in which the method of allocation to groups was not described).

Types of participants

Patients with chronic stable asthma.

Types of interventions

Studies had to include at least one treatment group in which speleotherapy was applied.

Types of outcome measures

Studies had to include objective or subjective parameters related to asthma, such as lung function, subjective symptoms, quality of life, medication use.

Search methods for identification of studies

Eligible trials were identified by the following means:

- 1) The Cochrane Airways Group Specialised Register of trials was searched (the most recent search was run in April 2006 and will be updated annually). The Register is derived from systematic searches of bibliographic databases including the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, EMBASE and CINAHL, and handsearching of respiratory journals and meeting

abstracts. All records in the Register coded as 'asthma' were searched using the following terms:

Spelaeo* or speleo* or spelio* or cave* or microclimat* or salina* or "salt min*" or "potash min*" or subterraneoatherap* or "vital air room" or halochamber* or biotron* or ionotron* or "climat* chamber*" or karst* or radon* or SaltPipe or Sopipa or BreathMaster

2) All citations identified (using the search term speleo*) in EMBASE (from 1991 onwards) and MEDLINE (from 1966 onwards) were screened by KL.

3) Institutions and subjects in Eastern Europe, Austria and Germany known to have expertise in speleoatherapy were contacted for further information by SB, AF and GF.

4) Speleological and caving journals as well as proceedings and abstracts from symposia on speleoatherapy were handsearched. (This strategy identified the largest number of possible relevant references)

5) References in the identified trials were checked for other possible relevant studies.

Data collection and analysis

Literature screening and selection of eligible trials:

As speleoatherapy research has rarely been published in MEDLINE- or EMBASE-listed journals the literature search had to rely primarily on contacting individuals or institutions and hand searching proceedings and abstract collections. As a first step one of the reviewers selected, from the pool of obtained material relating to the speleo-therapeutic treatment of asthma patients, those studies that were prospective, including uncontrolled case series and experiments. The studies had to include asthma patients (solely or as a separately reported subgroup) and report any clinical outcomes measures beyond "success rates". In a second step two reviewers selected from reports passing the first step those meeting the inclusion criteria. Disagreements were resolved by discussion.

Extraction of descriptive characteristics and study results were done by two reviewers using a standard form.

Regarding quality the following indicators were assessed by two reviewers independently:

- Was allocation to the compared groups described to be randomized?
- Was the concealment of randomization adequate?
- Was an attempt made to blind evaluators?
- Was there a detailed description of numbers and reasons for drop-outs and withdrawals in each group?
- Might results be biased due to drop-outs and withdrawals?

The primary studies were summarized descriptively because only a small number of trials were identified, the interventions were heterogeneous, and there was insufficient reporting of outcomes. The table of included studies provides a structured summary of the included studies. The following abbreviations were used in the table:

- Methods:

A = allocation to groups,

C = concealment of allocation,

B = blinding,

D = report of drop-out and withdrawals,

S = selection bias after allocation,

O = other information

- Patients:

N = number,

C = condition,

D = demographic information,

R = recruitment,

S = study setting

- Interventions:

S = speleoatherapy group,

C = control group

- Outcomes:

L = lung functions,

S = subjective symptoms,

M = medication

- Notes:

R = conclusion of the authors of the primary study,

C = comments

RESULTS

Description of studies

Only one study fully met the inclusion criteria (Novotny 1994). Two further studies (Agostini 1989, Makesowa 1989) did not describe how the patients were allocated to the groups, but randomization seemed unlikely in both. We decided to include these two studies given the scarce evidence available.

One study investigated the effects of speleoatherapy in a cave in the Lucca region (Alps of Carrara) in Italy (Agostini 1989), one in a Karst cave in the Czech Republic (Makesowa 1989), and one in a hot tunnel with a high radon level in Austria (Novotny 1994). All three studies were performed on asthmatic children (total number = 124). No study clearly specified inclusion and exclusion criteria.

An update search in April 2006 did not identify any further studies.

Risk of bias in included studies

The study of Novotny 1994 seems to be of reasonable quality although a number of details (exact inclusion criteria, concealment of randomization, completeness of follow-up, co-medication, measurement of subjective symptoms) remain unclear in the available reports. The studies by Agostini 1989 and Makesowa 1989 are reported in such a manner that a reliable assessment is impossible. However, strong doubts about the adequacy of the methods seem justified. The uneven number of patients in treatment and control group in the trials by Agostini 1989 et al. and the way of reporting the methods makes it unlikely that allocation had been randomized. The comparability of the groups is completely unclear. The same applies to the study by Makesowa 1989 which also gives no information on allocation, treatment and characteristics of the control group.

Effects of interventions

In the study of Novotny 1994 a slight improvement of the lung function was observed at the end of the 3-week treatment period. There were significant differences between treatment and control group in terms of MEF25% and MEF50% although FEV1 did not differ significantly. Nine weeks after treatment no difference between the groups was observed. The authors concluded that speleoatherapy

had a moderate, transient therapeutic effect. [Agostini 1989](#) reported that the children undergoing speleotherapy had better lung function parameters during and after the treatment phase while during follow-up no clear differences could be detected. The authors reported that the children in the treatment group needed less medication than those in the control group during the observation period. The reporting of [Makesowa 1989](#) regarding lung function allows no interpretation. The need of medication at follow-up seems to have been lower in the treatment group.

DISCUSSION

At the moment there is insufficient evidence to assess reliably whether speleotherapy (or some forms of it) is beneficial for asthma patients. Apart from the study of [Novotny 1994](#) we were not able to find a study which - at least in the form reported - had acceptable scientific quality.

Speleotherapy is relatively widespread in Eastern Europe and there may be relevant studies which we did not find, although we tried to contact experts in the field and asked them to provide data. The publication of this review may motivate researchers of speleotherapy to contact us and provide further studies. However, based on our contacts it does not seem likely that high-quality randomized trials of speleotherapy exist.

As the characteristics of caves and the treatment schedules vary strongly speleotherapy cannot be considered as one single treatment but rather a class of interventions. For example, the only study in our review which fully met the inclusion criteria ([Novotny 1994](#)) was performed in a site which has rather unique characteristics on a geophysical level. Positive or negative results obtained with a specific schedule in a defined cave cannot be extrapolated to speleotherapy in general.

Whether speleo-therapeutic treatment has relevant risks is also unclear. We did not find any systematic investigations on that

issue although the large number of treatments in Eastern Europe without reports on serious adverse effects suggests that at least short-term risks are small. The high level of radon in some caves has caused concern among some physicians and patients. For example, in an information leaflet on complementary therapies for patients the German Asthma league takes a sceptical position towards speleotherapy in radon caves.

AUTHORS' CONCLUSIONS

Implications for practice

At present it is not possible to make any recommendations for practice which are based on evidence from rigorous randomised controlled trials.

Implications for research

Further research on speleotherapy seems justified. Such research should be undertaken by institutions actually practicing speleotherapy and reflect current standards of clinical research on asthma. Randomized trials in subterranean 'speleo- hospitals' are actually being planned. However, funding for these trials is still a problem.

While it seems possible that speleotherapy has short-term beneficial effects the major question is whether any of these last over a longer period and whether the treatment is cost-effective.

It may be difficult to separate specific effects due to temperature, humidity, low levels of allergen and other geophysical properties from non-specific effects such as being under the earth. Such non-specific effects might be of major importance in speleotherapy.

ACKNOWLEDGEMENTS

We would like to thank Steve Milan for his help at all steps of the review

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CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Agostini 1989

Methods	A: unclear C: unclear B: unclear (probably no blinding) D: partly described S: major bias unlikely O: follow-up 12 months
Participants	N: 26 included, 23 analyzed (16 in the treatment and 7 in the control group) C: atopic asthma D: children (no further information) R: unclear S: four Italian clinics and institutes
Interventions	I: 78 to 110 hours in a cave (dolomite limestone and rock, 11°C, 98-100% humidity) during a 3 week period C: no speleotherapy No information on other therapies

Speleotherapy for asthma (Review)

Agostini 1989 (Continued)

Outcomes	L: improvement of lung function during the treatment phase in the speleotherapy groups, follow-up results do not seem to show a clear effect (insufficient data given) S: not mentioned M: seem to have been lower in the speleotherapy group
Notes	A: no conclusions presented C: insufficient presentation, study hardly assessable

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	Information not available

Makesowa 1989

Methods	A: unclear (randomisation unlikely) C: unclear (probably inadequate) B: probably none D: not described S: unclear O: possibly case-control design, follow-up between 1 and 5 years
Participants	N: included ?/? , analyzed 37/28 D: asthma (47 also had pollinosis) D: age 7 - 13 years, 47 boys, 18 girls R: unclear S: allergology department of National Health Institutes in Brno (Czech Rep.)
Interventions	I: speleotherapy in a local Karst cave (no further details) C: no speleotherapy (no further details) Both groups seem to have received anti-asthmatic drugs
Outcomes	L: no interpretable results presented S: no data presented M: drug use seems to be lower in speleotherapy group (presented results hardly interpretable)
Notes	A: positive C: insufficient presentation, therefore study could not be reliably assessed or interpreted

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	Information not available

Novotny 1994

Methods	A: children were matched into pairs (based on clinical symptoms, allergy status, lung function) and then randomized C: unclear D: not mentioned

Speleotherapy for asthma (Review)

Novotny 1994 (Continued)

S: unclear (but not likely)

Participants	N: 30 included, 30 analyzed (?) C: asthma (mean FEV1 before therapy slightly below 80% of the predicted value) D: age 7 to 15 years, 20 boys and 10 girls R & S: children were invited to a cost-free 3 week holiday in a health resort in Badgastein, Austria
Interventions	S: 10 times 1 hour stay in the radon-thermal climate (granite, 38-41.5°C, humidity 75-90%) C: no speleotherapy In addition both group participated to the same activity and free time programme in the resort. No information on medication
Outcomes	Outcome measurement 3 weeks before admission, at admission, at discharge and 9 weeks after discharge L: slight improvement in the speleotherapy group compared to control group (significant differences for MEF50% and MEF25% but not for FEV1), worsening in both groups after discharge (interpreted as a seasonal effect) S: no information M: no information
Notes	A: speleotherapy in the investigated cave has a moderate and transient therapeutic effect C: study seems to be quite reliable. Reporting not fully satisfactory; only minor additional information could be obtained

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	Information not available

Characteristics of excluded studies [ordered by study ID]

Study	Reason for exclusion
Bernatzky 1994	uncontrolled observational study
Homolka 1989	uncontrolled observational study
Khamzamylin 1990	not randomised
Lemko 1994	uncontrolled case series
Sokolov 1994	uncontrolled case series
Timová 1989	controlled study on recurrent obstructive bronchitis

WHAT'S NEW

Date	Event	Description
26 March 2019	Amended	Potentially eligible studies added to Studies awaiting classification .

HISTORY

Protocol first published: Issue 1, 1997

Review first published: Issue 2, 1999

Date	Event	Description
5 June 2014	Amended	PLS title updated
29 August 2008	Amended	Converted to new review format.
9 January 2001	New citation required and conclusions have changed	Substantive amendment

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- NHS Research and Development, UK.

External sources

- NIAMS Grant No 5 U24-AR-43346-02 (supporting KL), USA.
- Karl und Veronica Carstens-Stiftung (supporting KL), Germany.
- Askim Insurance Consultants, Histon, Cambridge (supporting SB), UK.

INDEX TERMS

Medical Subject Headings (MeSH)

Air Ionization; Asthma [*therapy]; Chronic Disease; Climate; Environment; Humidity; Naturopathy [*methods]

MeSH check words

Humans