
◎総説

Rehabilitation for patients with respiratory disease.
Spa efficacy in relation to pathophysiological
characteristics of bronchial asthma.

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Abstract : The number of patients with respiratory disease in the elderly has been increasing in recent years. Pathophysiological characteristic of respiratory diseases in older patients is clearly different from that in younger patients. In this study, rehabilitation for patients with respiratory disease, particularly bronchial asthma, in the elderly was discussed in relation to pathophysiology of asthma. Complex spa therapy has two kinds of actions, direct and indirect actions. Subjective and objective symptoms of patients with asthma are improved by spa therapy for 1 – 2 months, accompanied with improvement of ventilatory function, and decrease in bronchial hyperresponsiveness and respiratory resistance. In addition to these direct action of spa therapy, increase in strength of respiratory muscle, stability of autonomic nerve system, psychical relaxation, and improvement of suppressed function of adrenocortical glands are observed as indirect action of spa therapy. Regarding clinical asthma type classified by pathophysiological changes of the airways, spa therapy was more effective in patients with hypersecretion and bronchiolar obstruction. These results suggest that complex spa therapy is available as rehabilitation and/or treatment for patients with respiratory disease.

Key words : bronchial asthma, rehabilitation, complex spa therapy, ventilatory function, adrenocortical glands

Introduction

Rehabilitation for patients with respiratory disease has been noticed in recent years. Pulmonary rehabilitation is a multidimen-

sional continuum of services directed to persons with pulmonary disease and their families, usually by an interdisciplinary team of specialists, with the goal of achieving and maintaining the individual's maximum level

of independence and functioning in the community¹⁾. The program for pulmonary rehabilitation is intended in sequence : patient selection, initial evaluation, identify goal, components of a comprehensive care program, continuing assessment, repeat evaluation at conclusion and discharge from program. The treatment schedule comprises general treatment, medications, respiratory therapy, and rehabilitation medicine (chest physiotherapy, exercise reconditioning, occupational therapy, psychosocial rehabilitation, and vocational rehabilitation²⁾.

In this study, rehabilitation using hot spring for patients with asthma was discussed in relation to direct and indirect actions of spa therapy.

Asthma patients from distant areas

The number of patients with asthma from distant areas outside Tottori prefecture, who have been admitted at our hospital has been increasing in recent years³⁾, as shown in Fig. 1. In 1995, 125 patients with respiratory

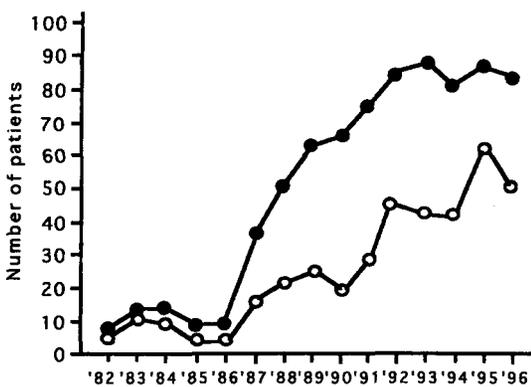


Fig. 1. Number of patients with bronchial asthma (●) and those from distant areas (prefectures other than Tottori) (○) admitted to Misasa Branch Hospital over the last 15 years

diseases were admitted at our hospital. Of the 125 patients, 112 (89.6%) were patients with chronic obstructive pulmonary disease (COPD) (91 with bronchial asthma, 4 with chronic bronchitis, 7 with obstructive bronchiolitis, and 10 with pulmonary emphysema). Larger number of patients was admitted from Hyogo, Osaka, Okayama, and Yamaguchi prefectures (Fig. 2).

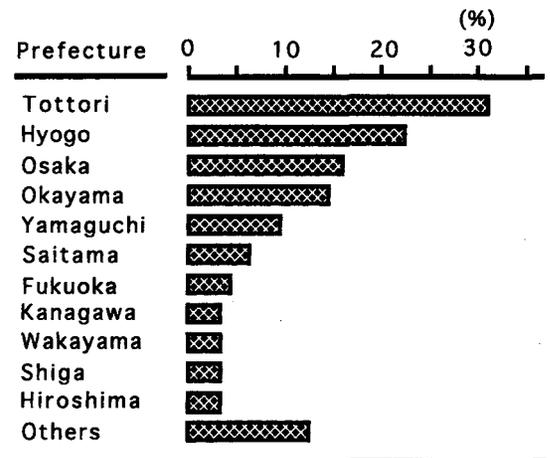


Fig. 2. Number of patients with respiratory disease who had spa therapy at our hospital and their resident areas (prefectures) in 1995

Regarding the distribution of patient age, the number of patients over the age of 70 was largest in patients inside Tottori prefecture. In contrast, the number of patients between the ages of 50 and 59, and between 60 and 69 was larger in patients from distant areas (Fig. 3). The frequency of bronchial asthma was predominantly larger among various respiratory diseases in patients inside Tottori prefecture (60.7%) and outside Tottori prefecture (82.3%)(Fig. 4).

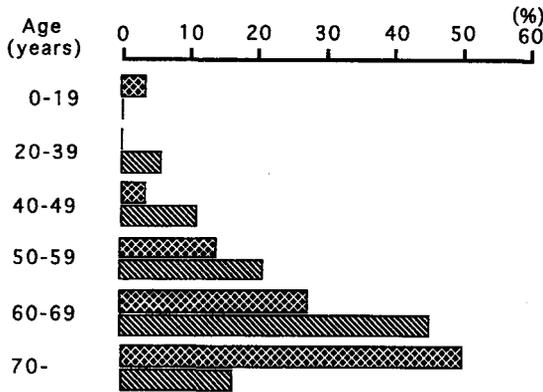


Fig. 3. Age of patients with respiratory disease in Tottori prefecture (▨) and from distant areas (▩) in 1995

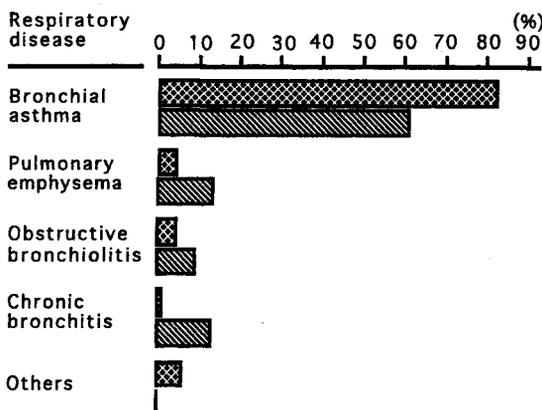


Fig. 4. Respiratory diseases and number of patients inside Tottori prefecture (▩) and those from distant areas (outside Tottori prefecture) (▨) in 1995

Problems in treatment for asthma

Limitation of exercise is often required in treatment for asthma to avoid exercise-induced bronchospasm and overload on heart stimulated with bronchodilators. Limitation of exercise and long-term systemic administration of glucocorticoids for intractable

asthma bring about osteoporosis, muscle weakness, and suppression of immunity which easily induces common cold and/or respiratory infection. Furthermore, limitation of exercise produces suppresses mental activity (Fig. 5). Adequate exercise is important in treatment for asthma to avoid suppression of immunity, osteoporosis and muscle weakness and to keep mental condition active.

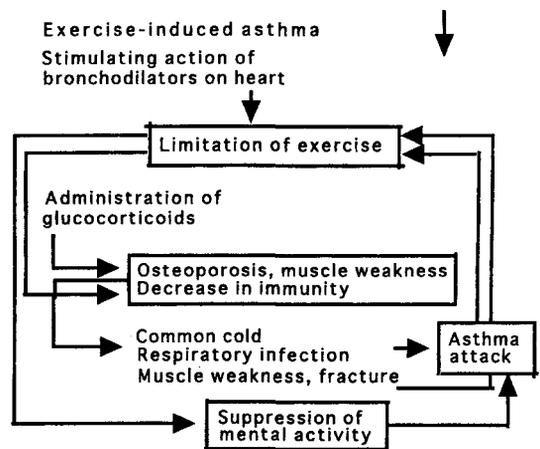


Fig. 5. Problems in treatment for asthma

Pathophysiology of the airways in asthma

Inflammation has been noted as the common pathophysiological changes in the airways of asthma. In inflammatory process various blood cells such as lymphocytes^{4, 5}, eosinophils^{6, 7}, and neutrophils migrate into allergic reaction site. Among these cells, activated T lymphocytes and eosinophils mainly participate in onset mechanisms of asthma⁶⁻¹¹. However, recent reports have suggested that neutrophils also play an important roles in induction of asthma attacks^{12, 13}.

Asthma is classified into three types according to cellular composition in the air-

ways: type Ia, type Ib and type II. Type Ia is divided into two subtypes according to the amount of expectoration; 0-49ml/day (type Ia-1) and 50-99ml/day (type Ia-2)¹⁴⁻²¹ (Table 1). The age when the symptoms of each asthma type begin is different

Table 1. Asthma classification by clinical symptoms and signs

Type	Clinical symptoms and signs
Ia. Simple bronchoconstriction	Patients with symptoms such as wheezing and dyspnea which are mainly elicited by bronchoconstriction This type is divided into two subtypes according to the amount of expectoration Ia-1: 0-49 ml/day Ia-2: 50-99 ml/day
Ib. Bronchoconstriction + hypersecretion	Patients with symptoms due to hypersecretion (more than 100 ml/day), in addition to bronchoconstriction
II. Bronchiolar obstruction	Patients with symptoms mainly elicited by bronchiolar obstruction

among the asthma types. The symptoms start to occur in their 20's in types Ia-1 and Ia-2, in their 30's in type Ib and in their 40's in type II asthma patients (Fig. 6)²¹. These clinical types of asthma are



Fig. 6. Relationship between clinical asthma types and patient age

closely related to airway inflammation. The mean proportion of neutrophils in bronchoalveolar lavage (BAL) fluid in patients with type II asthma is significantly larger than that in patients with type Ia-1 ($p < 0.001$), type Ia-2 ($p, 0 < 001$), and type Ib ($p < 0.001$) (Fig. 7).

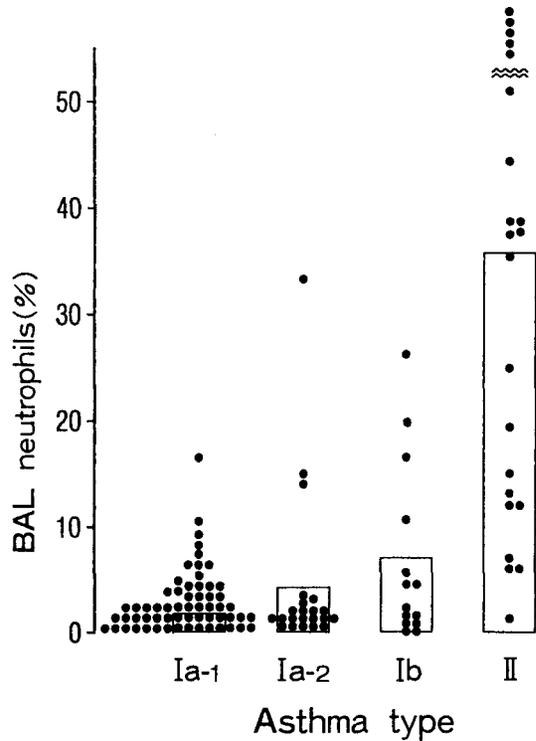


Fig. 7. Proportion of BAL neutrophils in each clinical asthma type. Vertical columns represent the mean for each group

However, recent studies have shown that there are some type II asthma patients without BAL neutrophilia^{22, 23}. Furthermore, type II asthma is characterized by predominant dysfunction of ventilation. The mean value of FEV 1.0% in patients with type II is significantly lower than that in asthma

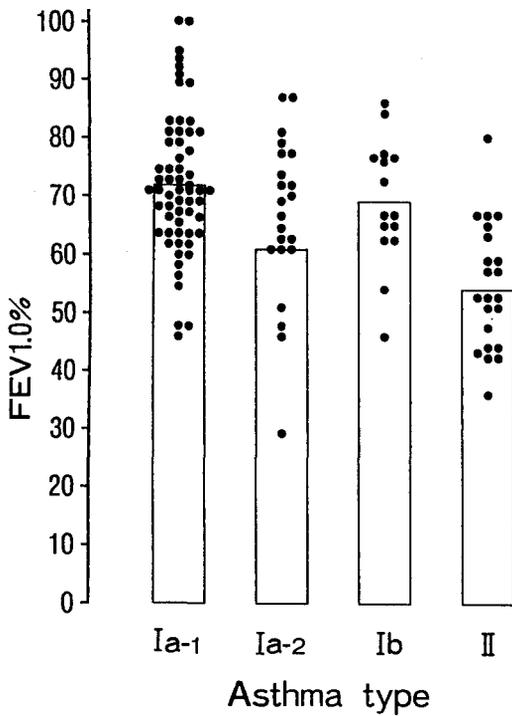


Fig. 8. FEV1.0% value in each clinical asthma type. Vertical columns represent the mean for each group

type Ia-1 ($p < 0.001$), type Ia-2 ($p < 0.02$), and type Ib ($p < 0.01$) (Fig. 8).

The value of \dot{V}_{25} in patients with type II is also significantly smaller than that in asthma type Ia-1 ($p < 0.001$), type Ia-2 ($p < 0.02$), and type Ib ($p < 0.01$) (Fig. 9)²¹.

In contrast, hypersecretion in the airways is closely related to BAL eosinophilia. The mean proportion of BAL eosinophils in patients with type Ib is significantly higher than that in asthma type Ia-1 ($p < 0.001$), type Ia-2 ($p < 0.02$), and type II ($p < 0.001$). The mean proportion of BAL eosinophils is also significantly larger in patients with type Ia-2 than in those with type Ia-1 ($p < 0.001$) (Fig. 10)^{21, 24}.

Spa therapy has two kinds of action mechanisms: direct and indirect actions. Improve-

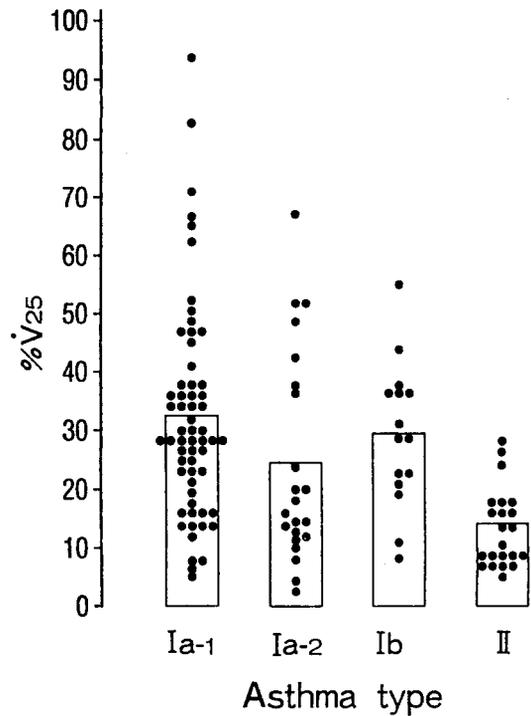


Fig. 9. \dot{V}_{25} value in each clinical asthma type. Vertical columns represent the mean for each group

ment of subjective and objective symptoms²⁵⁻³¹ and ventilatory function³²⁻³⁵, decrease in airway resistance, and improvement of bronchial hyperresponsiveness^{36, 37}) are observed as direct action of spa therapy. In contrast, increase in strength of respiratory muscle, stability of autonomic nerve system³⁸, psychological relaxation, and improvement of suppressed adrenocortical glands³⁹⁻⁴¹) are found as indirect action of spa therapy (Table 2).

Regarding ventilatory function, spa therapy improves low value of forced vital capacity (FVC), as well as low values of FEV 1.0, \dot{V}_{50} and \dot{V}_{25} , in patients with asthma. Increase in low value of FVC by spa therapy is significant in all age groups of asthma patients, but not in those over the age of 70 (Fig. 11). The increase of FVC after spa

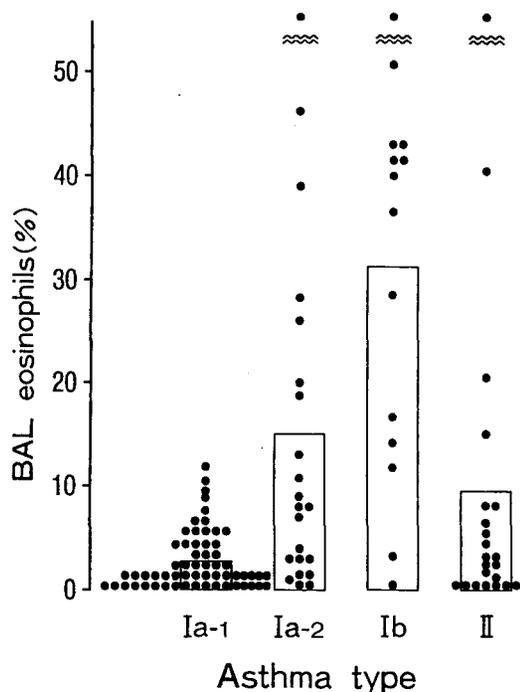


Fig. 10. Proportion of BAL eosinophils in each clinical asthma type. Vertical columns represent the mean for each group

Table 2. Action mechanisms of spa therapy on bronchial asthma

Direct action
Improvement of subjective and objective symptoms
Improvement of ventilatory function
Decrease in airway resistance
Improvement of bronchial hyperresponsiveness
Indirect action
Increase in strength of respiratory muscle
Stability of autonomic nerve system
Psychical relaxation
Improvement of adrenocortical glands

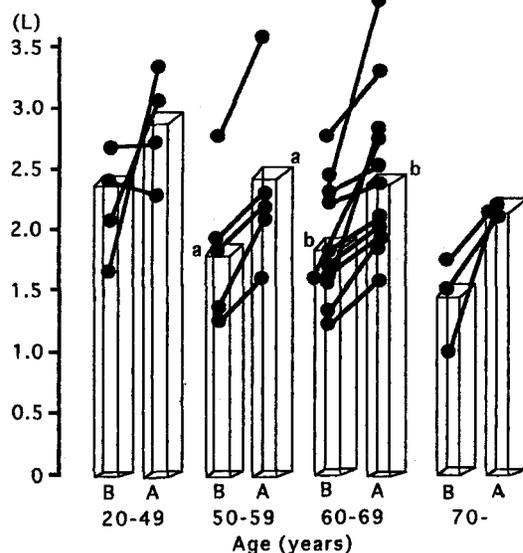


Fig. 11. Improvement of FVC by spa therapy in patients with asthma in relation to age. a, $p < 0.05$, b, $p < 0.05$. B ; before and A ; after spa therapy

therapy is also significant in patients with types Ia-1, Ia-2, and Ib, compared to the initial values, however, the increase is not significant in patients with type II asthma (Fig. 12)³⁰. Bronchial hyperresponsiveness is also suppressed by spa therapy³⁰. The action of spa therapy is speculated to be related to clinical effects of the therapy (Fig. 13).

The function of adrenocortical glands is often suppressed in patients with long-term systemic glucocorticoid therapy. Spa therapy improves suppressed function of adrenocortical glands³⁹⁻⁴¹. Serum cortisol levels significantly increase after spa therapy, compared with the initial levels before the therapy, in all age groups except the group over age 70 of asthma patients (Fig. 14). The increase in serum cortisol levels is more

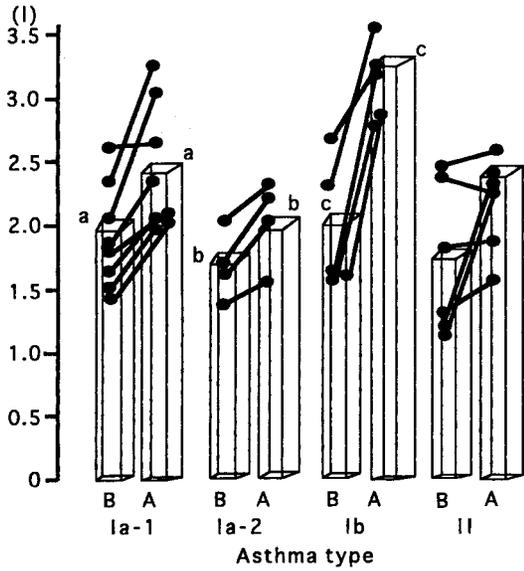


Fig. 12. Improvement of FVC by spa therapy in patients with asthma classified by clinical symptoms. B ; before spa therapy, A ; after spa therapy. a, $p < 0.001$, b, $p < 0.02$, c, $p < 0.01$

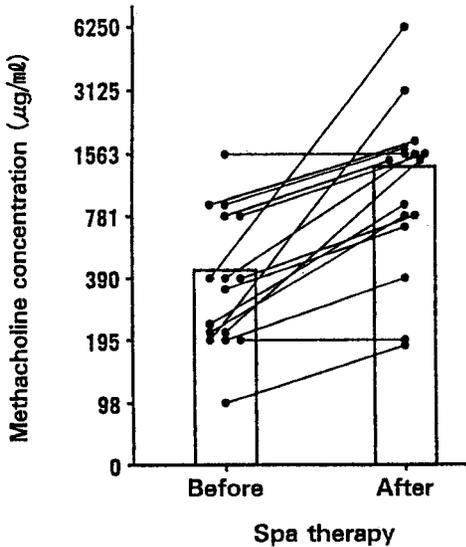


Fig. 13. Decrease of Bronchial reactivity after spa therapy in patients with bronchial asthma. Vertical columns represent the mean of subjects before and after spa therapy

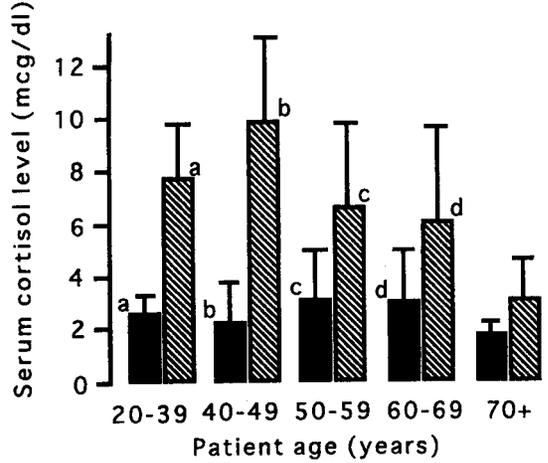


Fig. 14. Serum cortisol levels before (■) and after spa therapy (▨) and patient age. a and c ; $p < 0.001$, b and d ; $p < 0.05$

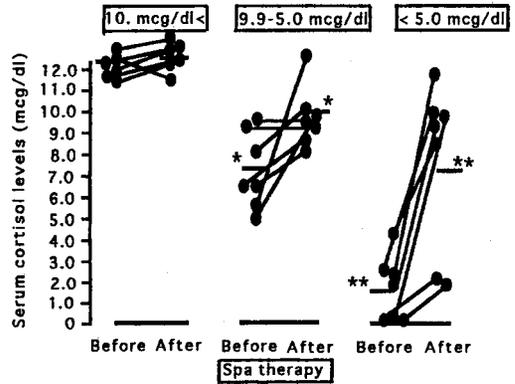


Fig. 15. Changes in serum cortisol levels before and after spa therapy in patients with bronchial asthma. * $p < 0.05$, ** $p < 0.01$.

predominant in patients with lower levels of serum cortisol before the therapy. Five of 7 patients with levels less than 5.0mcg/dl showed predominant increase after spa therapy (Fig. 15). With the increase in serum cortisol levels by spa therapy, the dose of glucocorticoids used to control asthma attacks can be reduced, accompanied with improvement of clinical symptoms (Table 3).

Table 3. Improvement of symptoms by spa therapy in each asthma type

Asthma type	No of patients	Reduction of prednisolone	Improvement of symptoms
Ia-1	9	5/9(55.6%)	6/9(66.7%)
Ia-2	8	7/8(87.5%)	8/8(100%)
Ib	7	4/7(57.1%)	7/7(100%)
II	9	4/9(44.4%)	6/9(66.7%)

The increase in serum cortisol levels is closely related to the effects of spa therapy. The levels were significantly increased after spa therapy in patients with marked and moderate efficacy of the therapy (Table 4).

Table 4. Serum cortisol levels and spa efficacy

Efficacy	No of patients	Serum cortisol levels (mcg/dl)	
		Before	After spa therapy
Marked	10	2.6 ± 1.4 ^a	10.0 ± 2.8 ^a
Moderate	27	2.9 ± 1.6 ^b	6.2 ± 2.6 ^b
Slight	7	2.3 ± 1.2	3.4 ± 2.2
No	2	4.0 ± 0.2	3.1 ± 2.3

a;p<0.001, b;p<0.001

Spa therapy has effects on psychological factors in patients with asthma⁴². In Cornell Medical Index (CMI), the mean point of physical symptoms decreased from 37.7 before spa therapy to 29.7 after the therapy. The mean improvement rate was observed in 90.0% of respiratory symptoms, 66.7% of CIJ symptoms, and 46.7% of psychical symptoms (Fig. 16). In Selfrating Depression Scale (SDS), many patients, who were admitted at our hospital for having spa therapy, showed more than 40, suggesting that they

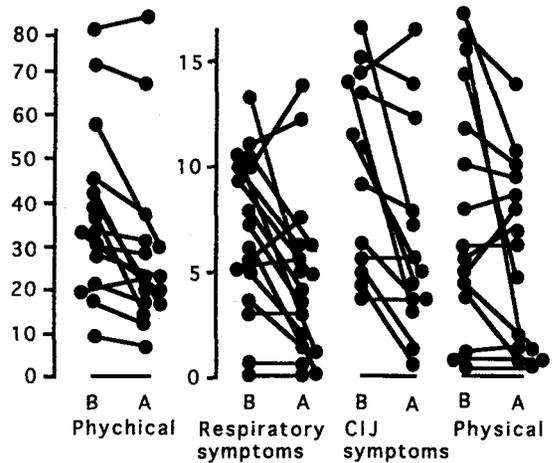


Fig. 16. Evaluation of spa effects by a CMI method in patients with bronchial asthma before (B) and after the therapy (A)

had depressive mental state. The mean point decreased from 42.9 to 40.7 by spa therapy (Fig. 17). In Comprehensive Asthma Inventory (CAI), categories of mental state, extent of conditioning, suggestion, fear of expectation, dependency, frustration and flight into illness, were clearly improved by spa therapy (Fig. 18-1, 2).

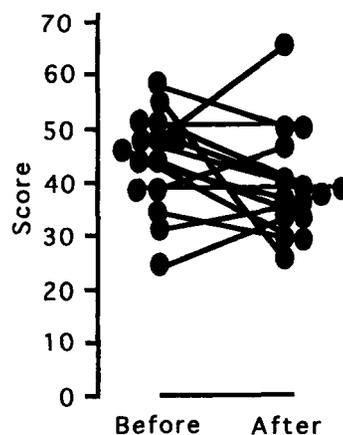


Fig. 17. Evaluation of spa effects by a SDS method in patients with bronchial asthma

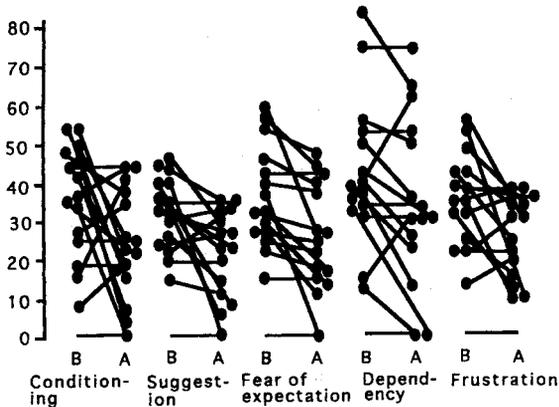


Fig. 18-1. Evaluation of spa effects by a CAI method in patients with bronchial asthma before (B) and after the therapy (A)

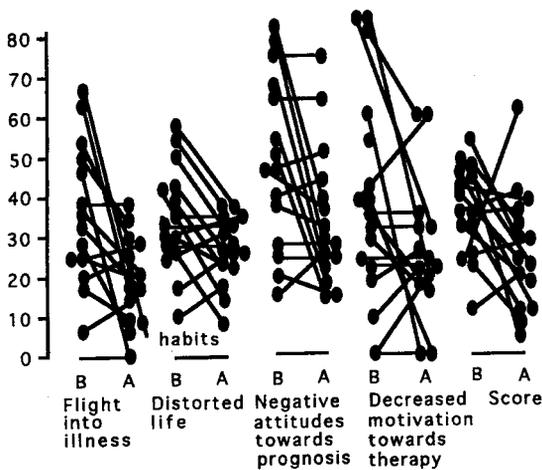


Fig. 18-2. Evaluation of spa effects by a CAI method in patients with bronchial asthma before (B) and after the therapy (A)

Clinical effects of spa therapy

Our previous studies have shown that spa therapy is effective in patients with bronchial asthma, particularly in patients with steroid-dependent intractable asthma (SDIA)^{26, 41}. In SDIA, airway inflammation including inflammatory cells and, chemical mediators and cytokines from these cells are affected

by long-term systemic administration of glucocorticoids⁴³⁻⁴⁵, leading to difficulty of the treatment for asthma. The efficacy of spa therapy is different between younger and older patients with asthma. Spa therapy is more effective in patients over the age of 60 than in those between the ages of 20 and 59.

Bronchial hyperresponsiveness is significantly improved both in younger and older patients by spa therapy (Fig. 19). The bronchial reactivity of atopic asthma is stronger in patients without spa effects than in those with spa efficacy, however, the reactivity is not different between effective and non-effective subjects in nonatopic asthma (Fig. 20). Furthermore the efficacy of spa therapy is not same among clinical asthma types. Spa therapy is more effective in type I b⁴⁶ and type II^{23, 28} than in type I a⁴⁷. These results suggest that clinical asthma types and patients age should be considered to obtain enough effects of spa therapy in treatment for asthma.

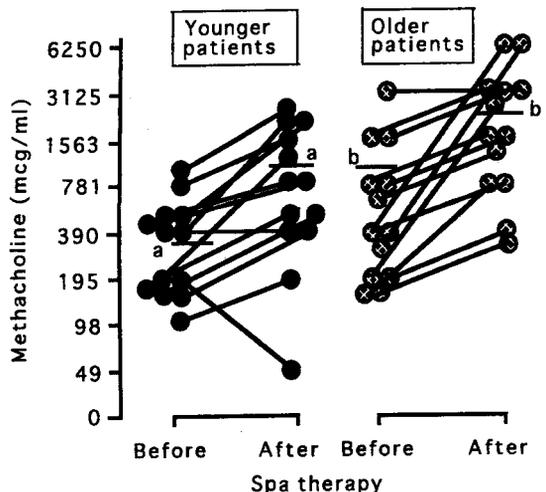


Fig. 19. Improvement of bronchial sensitivity by spa therapy in patients with asthma. a : $p < 0.01$, b : $p < 0.02$

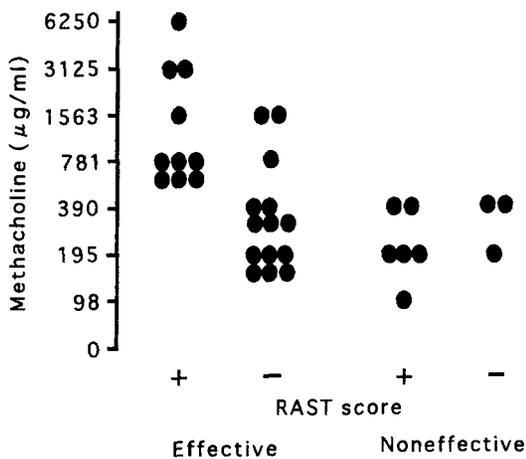


Fig. 20. Comparison of bronchial hyperresponsiveness between effective and noneffective subjects with spa therapy

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呼吸器疾患のリハビリテーション。気管支喘息の病態的特徴と関連した温泉療法の効果

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近年老年者の呼吸器疾患が増加しつつある。老年者の呼吸器疾患の病態的特徴は若年者のそれとは明らかに異なっている。本論文では、老年者の呼吸器疾患、なかでも気管支喘息に対する温泉療法を中心としたリハビリテーションについて、その病態的特徴と関連して若干の知見を述べる。

複合温泉療法は2つの作用、すなわち直接作

用と間接作用を有している。患者の自覚症状は1-2カ月の温泉療法により明らかに改善傾向を示すが、同時に、換気機能の改善、気道過敏性や気道抵抗の低下が観察される。これらの温泉療法の直接作用のほか、呼吸筋の増強、自律神経系の安定化、精神的リラクセス、低下した副腎皮質機能の改善、などの間接作用も観察される。気道の病態生理的特徴より分類した喘息の臨床病型に関しては、過分泌や細気管支閉塞を伴うような病型に対して、温泉療法は有効性が高い。これらの結果は、複合温泉療法が呼吸器疾患の治療ないしリハビリテーションとして有用であることを示している。

キーワード：気管支喘息、リハビリテーション、複合温泉療法、換気機能、副腎皮質