

SHORT COMMUNICATION

Drinking deep-sea water restores mineral imbalance in atopic eczema/dermatitis syndrome

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Objective: The effect of drinking deep-sea water on hair minerals was studied in patients with atopic eczema/dermatitis syndrome (AEDS). Study of hair minerals revealed an imbalance of essential minerals and an increase in toxic minerals in AEDS patients.

Design: After drinking deep-sea water (Amami no Mizu) for 6 months in AEDS patients, hair minerals (essential minerals and toxic minerals), clinical evaluation of the skin symptoms were compared before drinking with after drinking.

Subjects: After obtaining informed consent, 33 patients (mean age 26 y, range 1–50 y, 13 male and 20 female subjects) with mild to moderate AEDS were enrolled.

Results: After drinking deep-sea water, the levels of the essential mineral, potassium (K), were significantly decreased, while the levels of selenium (Se) increased. On the other hand, drinking deep-sea water significantly decreased the levels of the toxic minerals, mercury and lead. Moreover, after drinking deep-sea water, the skin symptoms were improved in 27 out of 33 patients.

Conclusion: These results indicate that the mineral abnormalities/imbalance may be involved in the pathogenesis of AEDS, and that drinking deep-sea water may be useful in the treatment of AEDS.

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Introduction

We have previously reported that the ratio of the essential minerals, Ca/Mg, and levels of the toxic minerals, Al, Hg, and Pb, were increased in hair from patients with atopic eczema/dermatitis syndrome (AEDS) (Kimata *et al*, 2002). In addition, drinking deep-sea water, Amami no Mizu Hardness 1000 (Ako Kasei Co., Ltd.) restored the Ca/Mg ratio to normal and reduced the levels of toxic minerals, Al, Hg, and Pb in hair, whereas drinking mineral water failed to do so (Kimata *et al*, 2002). These results indicated that AEDS patients may exhibit an imbalance of essential minerals, while concurrently exhibiting an accumulation of toxic minerals. Deep-sea water, Amami no Mizu Hardness 1000 (Ako Kasei Co., Ltd.), which was obtained at a depth of 344 m and subsequently refined, contained Mg in addition to other minerals. The quantity in 500 ml (ie, Mg (200 mg/l), Na (74 mg/l), Ca (71 mg/l), K (69 mg/l), Zn (4.0 µg/ml), Cu

(4.4 µg/ml), I (2.8 µg/ml), P (9.0 µg/ml), Se (0.4 µg/ml)). Here, we analyzed 25 minerals, including 12 essential minerals, eight supposed essential minerals and five toxic minerals, in hair samples from 33 AEDS patients before and after drinking of deep-sea water.

Subjects and methods

Subject

After obtaining informed consent, 33 patients (mean age 26 y, range 1–50 y, 13 male and 20 female subjects) with mild to moderate AEDS were enrolled. Patients were asked to maintain their skin treatment with nonsteroidal ointment(s), but to restrict the use of steroid ointment(s).

Sample and ingestion method

Amami no Mizu Hardness 1000 is a product of Ako Kasei Co., Ltd., and is a bottled water which is rich in Mg (Kimata *et al*, 2002). It is made from deep-sea water by removing NaCl and prepared at a concentration of Mg/Ca that is equivalent to

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hardness 1000. Deep-sea water was obtained from the sea off the coast of Muroto in Kochi Prefecture. Patients ingested 500 ml/day of deep-sea water, Amami no Mizu Hardness 1000, for 6 months.

Evaluation

Before and after drinking the deep-sea water for 6 months, hair minerals were analyzed by inductively coupled plasma mass spectrometry at the LBV Preventive Medicine Laboratory (Tokyo, Japan). In addition, clinical improvement was assessed as previously reported (Hanifin & Rajka, 1980; Kimata *et al*, 2002). Clinical evaluation of the skin symptoms were performed using a scoring system. Grading was 0–2 in increasing severity with respect to inflammation, lichenification and cracking. Inflammation was scored as follows: inflammation-free 0 points, erythema only 1 point, erythema with swelling 2 points. Lichenification was scored by lichenification-free 0 points, slight increase of a criss-cross skin pattern 1 point, considerable increase of criss-cross skin pattern with or without skin thickening 2 points. Cracking was scored by cracking-free 0 points, occasional small cracks 1 point, troublesome large cracks 2 points. These parameters were assessed on 15 areas of the body. The areas were face, scalp, neck, right arm, left arm, right hand, left hand, trunk, back, pelvis, buttock, right leg, left leg, right foot, and left foot.

The clinically evaluated skin symptoms were compared before and after drinking Amami no Mizu. These parameters were considered 'markedly changed' when significant differences were observed. 'Improvement' was concluded when changes occurred in the direction of improvement. 'No change' in the parameter was concluded when the symptoms were the same. 'Aggravation' was concluded when the parameter worsened. Statistical analyses were performed with Student's *t*-test. *P*-values <0.05 were considered statistically significant.

Results

Effect of drinking deep-sea water on essential minerals

As shown in Table 1, among the 12 essential minerals studied, the levels of Cr and Cu were above the normal range, whereas the levels of Se were below the normal range. After drinking deep-sea water, the K levels were significantly decreased (K: *P*=0.0004), whereas the Se levels increased significantly (Se: *P*=0.0001). Furthermore, the levels of Mg exhibited a trend to increase, although no statistically significant difference was observed.

Since the essential minerals interact mutually (Kimata *et al*, 2002), the ratios of essential minerals were analyzed. The ratios of K/Fe, Ca/Mg and Zn/Se decreased significantly (K/Fe : *P*=0.0012, Ca/Mg : *P*=0.0003, Zn/Se : *P*=0.0034) from 9.6 to 3.4 (K/Fe : normal range:0.9–5.1), from 8.6 to 6.2 (Ca/Mg : normal range:4.0–500), from 549.4 to 395.9 (Zn/Se : normal range : 21.4–200), while the ratio of Na/K increased significantly (Na/K : *P*=0.0065) from 1.6 to 4.4. The ratio of Mg/K exhibited a tendency towards an increase although there the difference was not statistically significant. Nonetheless, these results indicated that there was an imbalance of essential minerals in the AEDS patients, and that drinking deep-sea water improved the mineral imbalance.

Effect of drinking deep-sea water on supposed essential minerals

As shown in Table 2, the levels of Ni, B and I were above the normal ranges, and drinking deep-sea water tended to decrease Ni and I, although the differences were not statistically significant. In contrast, drinking deep-sea water significantly decreased the levels of B (*P*=0.0362). Furthermore, the levels of Ge were below the normal range and drinking deep-sea water significantly increased the levels of Ge (*P*=0.0001).

Table 1 Effect of drinking deep-sea water on essential minerals in hair

Mineral	Normal range (ppb)	Before ^a	After ^a	P-value ^b
Na	30 000–910 000	56 031 (22 738)	61 942 (22 497)	NS
K	6000–407 000	49 404 (9791)	18 860 (3411)	<0.0005
Mg	12 000–108 000	102 076 (14 966)	18 8317 (47 820)	NS
Ca	100000–1 560 000	840 230 (124 882)	788 227 (15 750)	NS
Cr	65–165	176 (13)	212 (21)	NS
Mo	29–48	36 (5)	41 (7)	NS
Mn	98–352	224 (43)	200 (46)	NS
Fe	4000–47 000	6138 (427)	7131 (742)	NS
Cu	6000–19 000	33 892 (8676)	30 861 (5579)	NS
Zn	760 000–231 000	192 310 (15 583)	195 643 (17 452)	NS
P	126 000–222 000	148 697 (4335)	150 752 (6315)	NS
Se	900–5000	443 (29)	565 (28)	<0.0001

^aValues are the means (s.d.).

^bNS: Not significant.

Table 2 Effect of drinking deep-sea water on supposed essential minerals in hair

Minerals	Normal range (ppb)	Before ^a	After ^a	P-value ^b
Li	1.3–8.0	7.8 (2.3)	8.9 (4.0)	NS
V	8.0–95.0	112.8 (28.3)	97.9 (22.4)	NS
Co	6.0–40.0	22.8 (2.5)	64.6 (35.2)	NS
Ni	125.0–1700.0	1209.6 (520.3)	639.1 (192.1)	NS
B	100.0–500.0	503.4 (82.2)	298.6 (61.6)	<0.05
Ge	70.0–150.0	65.3 (6.5)	148.2 (6.5)	<0.0001
Br	600.0–12000.0	3600.1 (784.3)	9949.5 (4511.2)	NS
I	15.0–150.0	5986.3 (4506.9)	832.9 (478.4)	NS

^aValues are the means (s.d.).^bNS: Not significant.**Table 3** Effect of drinking deep-sea water on toxic minerals in hair

Mineral	Normal range (ppb)	Before	After	P-values
Cd	4.5–49.0	18.1 (2.8)	15.1 (2.6)	NS
Hg	1100.0–5650.0	3914.3 (473.3)	2776.9 (379.5)	0.0015
Al	1900.0–9500.0	5303.5 (815.6)	4478.8 (629.4)	NS
Pb	170.0–1700.0	1278.2 (262.0)	864.9 (160.5)	0.0254
As	11.0–80.0	40.3 (4.8)	46.2 (5.6)	NS

Values are the means (s.d.).

Table 4 Clinical evaluation of the skin symptoms

Evaluation	Number of patients
Markedly improvement	16
Improvement	11
No change	6
Aggravation	0

A total of 33 AEDS patients were evaluated for skin symptoms after drinking deep-sea water for 6 months.

Effect of drinking deep-sea water on toxic minerals

As shown in Table 3, although the five toxic minerals studied were within the normal ranges, drinking deep-sea water significantly decreased the levels of Hg and Pb.

Results of improvement of skin symptoms

The clinical assessment is summarized in Table 4. Skin symptoms were improved in 27 out of 33 patients.

Discussion

We have demonstrated that AEDS patients typically exhibit an imbalance of various essential minerals in hair, and drinking deep-sea water was able to restore them. In addition, drinking deep-sea water decreased the levels of toxic minerals in hair. Although the levels of toxic minerals were not above the normal ranges, it was possible that these toxic minerals could be harmful to the skin. Analysis of mineral levels in skin would be necessary in future.

The exact mechanism(s) of the mineral imbalance remains to be elucidated. However, this is not surprising. In a preliminary study, we have previously reported a mineral imbalance in AEDS patients (Hanifin & Rajka, 1980; Kimata *et al*, 2002). Moreover, skin barrier recovery is influenced by the electric charge of minerals in the epithelium (Edelberg, 1977; Denda *et al*, 2000; Denda & Kumazawa, 2002). Mg deficiency results in AEDS-like symptoms in hairless rats (Neckermann *et al*, 2000a, b; Makiura *et al*, 2004). Moreover, it has also been reported that the skin barrier and also the intestinal barrier was impaired in AEDS, and consequently, intestinal permeability was enhanced, which resulted in the accumulation of sugar and fat (Ukabam *et al*, 1984; Kimata, 2001). Therefore, it is possible that various toxic minerals were easily absorbed and accumulated in tissues.

The restorative effect of drinking deep-sea water on mineral abnormalities is not surprising. In our preliminary study of a small number of AEDS patients, we reported that drinking deep-sea water restored the Ca/Mg ratio and Al, Hg, and Pb levels in these patients (Kimata *et al*, 2002). The present investigation confirms these results in a larger number of AEDS patients. Drinking deep-sea water increased the levels of selenium (Se). Se is a potent free radical scavenger, and it has been reported that free radicals worsen AEDS (Niwa & Iizawa, 1994; Niwa *et al*, 2003). Thus, it would be tempting to speculate that deep-sea water increased Se levels, which in turn improved AEDS. This possibility is currently under investigation.

Ito *et al* (2003) have reported that in rats, greater absorption of minerals occurs from the water than from solid feed. In our observation, it seems reasonable to

conclude that drinking deep-sea water improves the balance of minerals, such as Na and K that are important for maintaining acid and alkali balances in body. In addition, drinking deep-sea water reduces allergic skin responses in patients with allergic rhinitis (Kimata *et al*, 2001). An isotonic sea water-derived solution has been shown to impair chemokine IL-8 expression and secretion by human respiratory epithelial cells (Tabary *et al*, 2001). Mineral-rich thermal water can reduce expression of costimulatory molecules (HLA-DR, ICAM-1, and B7-2) in human Langerhans cells (Staquet *et al*, 2002). On the other hand, mineral imbalance has been demonstrated in tissues of patients with allergic diseases. Intracellular Mg levels in erythrocytes, but not serum Mg levels, were reduced in patients with bronchial asthma (Emelyanov *et al*, 1999). Thus, based upon the blood levels of Ca and Mg in adult AEDS patients and the blood levels of Zn in childhood AEDS patients, our results of hair mineral imbalance are not comparable to those of blood (David *et al*, 1984).

It has also been reported that analysis of hair mineral levels is more appropriate than analysis of blood minerals in assessing mineral balance in the body (Wilhelm *et al*, 1989; Sanna *et al*, 2003). Collectively, these results indicate that AEDS patients may have essential mineral imbalance and accumulation of some toxic minerals. Drinking deep-sea water may restore these abnormalities, and thus it may be useful in the study and the treatment of AEDS. Although serum IgE and blood eosinophil count were not measured in this study, we have previously reported that drinking deep-sea water decreased serum allergen-specific IgE levels in AEDS patients (Kimata *et al*, 2002) or patients with allergic rhinitis (Tabary *et al*, 2001). Blood eosinophil numbers did not change in those studies (unpublished data).

Studies are currently in progress to further elucidate the mechanisms involved.

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