Quantitative Evaluation for Effects of Hyperbaric Oxygen Treatment on Patients with Ankle Sprain at an Acute Phase.

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Background:

Ankle sprain is a major soft tissue injury during sports activity, which causes localized edema and pain at an acute phase, and sometimes involves joint capsule and/or ligamentous injuries.

HBO involves the effect of edema reduction[1,2] and improvement from injured tissue hypoxia, and it is expected that HBO can accelerate reduction of subjective pain, and promote the healing processes of injured tissues.

The purpose of this study was to identify the effects of HBO on reduction edema and pain in patients with ankle sprain at an acute phase.

Patients and Methods:

Twenty patients with acute ankle sprains that occurred during sports activity between 2007 and 2012, who visited our clinic within 7 days after the injury, were investigated in this study. The HBO application was performed with 2.5 ATA for 60 minutes from once to 5 times.

- The foot and ankle volume evaluated with water-filled volumetric gauge (Fig. 1-a, b).
- Visual analog scales (VASs), which question included pain at rest, pain while walking, and subjective evaluation for edema, were evaluated just before and after HBO.

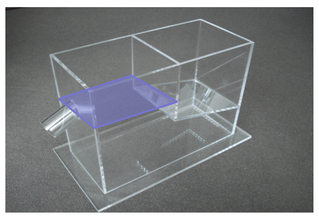

Fig. 1-a

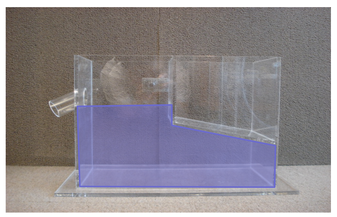

Fig. 1-b

Results:

Ankle volumes at pre HBO and post HBO were respectively 1,562 ± 203 cm^3 and 1,547 ± 199 cm^3($p<0.001$). Reduction of ankle volume were 18 cm^3 at the 1st HBO, 14 cm^3 at the 2nd HBO, 16 cm^3 at the 3rd HBO, 5 cm^3 at the 4th HBO, and 6 cm^3 at the 5th HBO (Table 1, 2).

VAS scores at before and after HBO regarding pain while walking were respectively 41.7 and 30.3 points ($p<0.001$), and those regarding subjective evaluation of edema were respectively 48.0 and 42.2 points ($p<0.01$) (Fig. 2).

VAS scores regarding pain while walking depending on HBO times were respectively 67.1 and 48.1 at the 1st HBO, and 34.6 and 28.1 at the 2nd HBO (Table 3, 4).

Table 1: Foot and ankle volume depending on HBO times

HBO time(s) (n)	pre-HBO	post-HBO	
1(20)	1581.8±202.5	1564.3±196.2	***
2(16)	1598.0±184.2	1584.1±179.1	**
3(14)	1561.9±188.4	1545.2±195.1	*
4(8)	1495.6±212.9	1490.9±109.5	
5(2)	1336.5±433.5	1330.0±405.9	

*** P<0.001 ** P<0.01 * P<0.05

Table 2: Foot and ankle volume depending on duration from injury

Duration from injury day(s) (n)	pre-HBO	post-HBO	
1 (4)	1541.7±302.3	1532.0±304.5	
2 (12)	1593.1±197.6	1578.0±199.2	*
3 (14)	1537.4±201.3	1525.6±194.0	**
4 (12)	1541.5±197.4	1520.3±194.1	***
5 (11)	1515.1±218.3	1509.7±217.6	
6 (4)	1663.3±211.9	1639.0±185.5	
7 (2)	1696.5±75.7	1676.5±84.1	

*** P<0.001 ** P<0.01 * P<0.05

Table 3: VAS scores depending on HBO times

HBO time(s) (n)	pain at rest		pain while walking		subjective evaluation of edema (point)	
	pre-HBO	post-HBO	pre-HBO	post-HBO	pre-HBO	post-HBO
1 (15)	33.9 ± 27.0	27.6 ± 22.1**	67.1 ± 19.3	48.1 ± 19.3***	67.2 ± 24.4	62.4 ± 17.5
2 (12)	21.7 ± 14.4	12.8 ± 10.5**	34.6 ± 14.5	28.1 ± 13.0	51.2 ± 19.6	39.1 ± 20.6 *
3 (13)	13.3 ± 10.4	16.3 ± 17.6	32.9 ± 19.9	21.8 ± 16.3**	37.2 ± 19.1	33.8 ± 19.7
4 (8)	9.3 ± 7.7	9.5 ± 9.7	19.6 ± 9.8	15.3 ± 10.7	27.6 ± 11.6	24.5 ± 9.9
5 (1)	4	9	38	19	27	27

*** P<0.001 ** P<0.01 * P<0.05

Table 4: VAS scores depending on duration from injury

Duration from injury day(s) (n)	pain at rest		pain while walking		subjective evaluation of edema (point)	
	pre-HBO	post-HBO	pre-HBO	post-HBO	pre-HBO	post-HBO
0 (1)	81.0	66.0	89.0	70.0	14.0	74.0
1 (2)	27.5 ± 33.2	21.5 ± 26.1	52.5 ± 12.0	43.0 ± 1.4	60.5 ± 17.7	60.0 ± 18.4
2 (9)	29.8 ± 23.4	23.8 ± 20.1*	62.8 ± 25.4	40.4 ± 22.5***	71.7 ± 18.2	55.4 ± 20.3**
3 (13)	23.8 ± 20.0	16.9 ± 15.2**	44.5 ± 23.2	34.8 ± 19.4**	58.4 ± 21.0	50.4 ± 20.1***
4 (11)	14.8 ± 10.8	12.8 ± 12.4	32.1 ± 16.7	21.6 ± 16.2	40.4 ± 18.9	33.0 ± 21.1
5 (11)	10.6 ± 9.3	15.7 ± 17.7	27.4 ± 17.7	21.9 ± 14.6	28.7 ± 17.8	26.9 ± 17.6
6 (2)	12.5 ± 17.7	4.0 ± 4.2	26.5 ± 13.4	15.5 ± 17.7	27.5 ± 17.7	30.0 ± 14.1

*** P<0.001 ** P<0.01 * P<0.05

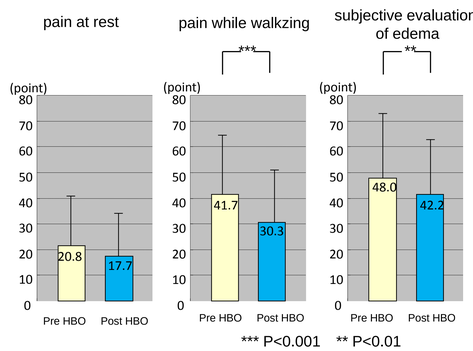

Fig. 2: Visual analog scale (VAS) score

Discussion:

In this study, HBO was effective for reducing ankle edema and pain in patients with ankle sprains at an acute phase.

The statistically significant efficacy were observed within 4 days after injury by the evaluation of the foot and ankle volume, and within 3 times HBO by the evaluation of VAS scores. The application of HBO was recommended within 3 times HBO, or 4 days after injury in patients with ankle sprain at an acute phase.

Conclusion:

1. HBO was effective for reducing ankle edema and pain in patients with ankle sprains at an acute phase.
2. Judging from the data of the ankle volume and the VAS scores in this study, HBO was significantly effective within the 3 times or 4 days after injury.

References

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