

## METHODS

# Adaptation to Hypoxia as a Method of Treatment and Prevention of Gastroduodenal Mucosa Lesions

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Translated from *Byulleten' Eksperimental'noi Biologii i Meditsiny*, Vol. 132, No. 9, pp. 358-360, September, 2001  
Original article submitted July 2, 2001

Intermittent normobaric hypoxia (13-23 daily sessions 30-50 min each) alleviated the dyspeptic and pain syndromes, improved the objective characteristics of the gastrointestinal tract, and promoted healing of duodenal and peptic ulcers.

**Key Words:** *intermittent normobaric hypoxia; peptic ulcer*

Experimental and clinical studies showed that hypoxic training improved body resistance in various pathological conditions. Published reports indicate that treatment with artificial mountain climate or intermittent normobaric hypoxia (INH) is effective in asthma, chronic nonspecific pulmonary diseases, allergic diseases, neurocirculatory dystonia, essential hypertension, coronary heart disease, and metabolic disorders. Sessions of hypoxic therapy eliminate side effects of drugs, improve total nonspecific resistance, resistance to hyperoxia, and radiation resistance [1-4,6-8,10,11].

In 1992 we reported our experimental findings on reparative effect of hypoxic stimulation in patients with peptic ulcer (PU) [9]. The search for new methods of treatment of PU involving other gastrointestinal organs and associated with complications and relapses remains a pressing problem [5]. Here we investigated the possibility of using adaptation to hypoxia for the treatment and prevention of gastroduodenal mucosa lesions.

## MATERIALS AND METHODS

The effects of low partial oxygen pressure on the gastrointestinal mucosa was studied in 37 patients with

duodenal ulcer (21-45 years) and 9 patients with peptic ulcers (44-54 years). Men predominated among the patients ( $n=36$ ). The disease duration was less than 5 years in 15 patients, 5-10 years in 11, and more than 10 years in 10 patients.

All patients received INH sessions with 10% oxygen in nitrogen in the cyclic-fraction mode: during the first 3 days each cycle consisted of breathing hypoxic mixture for 7 min and atmospheric air for 3 min, the total duration of the session was 1 h (6 cycles). Starting from day 4 each cycle consisted of breathing hypoxic mixture for 15 min and atmospheric air for 7 min, each session consisted of 4 cycles, the total duration was 1 h 28 min. The duration of the treatment was 13-23 days.

Initially, PU relapse was endoscopically confirmed in 36 patients; in 12 patients duodenal ulcer was complicated by erosive gastritis. In other 10 patients PU relapse was confirmed clinically. Six patients (2 with gastric ulcers) received drug therapy for 3-4 weeks at the Gastroenterological Department. In 3 of them clinical effect was poor and virtually no endoscopic changes were seen. Three patients with clinically confirmed PU exacerbations received outpatient therapy for 2-3 weeks; clinical effect was poor.

## RESULTS

Endoscopic control during the treatment was carried out in 22 patients (61%). In 14 patients with ulcer

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defects of  $7.4 \pm 0.9 \times 8.5 \pm 0.8$  mm the ulcers healed (in 4 of them INH was combined with drug therapy which was previously little effective and in 3 virtually no endoscopic changes were detected before INH), in 8 patients ulcer defects decreased from  $9.2 \pm 1.9 \times 11 \pm 1.5$  mm to  $3.8 \pm 1.1 \times 4.7 \pm 1.4$  mm. On the whole, endoscopy showed that ulcers healed in 64% patients and positive changes (decrease of ulcers and inflammations) were observed in 36% patients.

Ulcers decreased in size after 13-15 days of INH treatment and healed in patients receiving INH for 19-23 days.

Before the start of INH, 44 of 46 patients (95.7%) complained of pain; after INH course pain disappeared in 36 (69.6%) and decreased in 12 (26.1%) patients.

Before INH the pain syndrome was detected by palpation in 44 (95.7%) patients, moderate to severe pain was noted in 33 (71.7%) patients and in 9 patients (25%) pain syndrome was associated with signs of perivisceritis. After INH therapy pain was no longer detected by palpation in 28 patients (61%) and in 12 patients (26%) slight pain syndrome was found. In 1 patient (2.3%) moderate pain syndrome with slight symptoms of perivisceritis persisted, which suggest that the course of INH was insufficiently long for this patient.

Slight to moderate dyspeptic syndrome was initially found in 33 (72%) and severe in 5 (11%) patients. After INH course this syndrome disappeared in 33 (72%) and decreased in 5 (11%) patients.

Asthenoneurotic syndrome before treatment was slight to moderate in 28 (61%) and pronounced in 6 (13%) patients. After INH course it disappeared in 20 (43.5%) and decreased in 14 (30.4%) patients.

Laboratory tests before therapy revealed C-reactive protein in 14 patients and high erythrocyte sedimentation rate (ESR, 20-24 mm/h) in 7 patients. After INH therapy C-reactive protein was not detected and ESR returned to normal. Erythrocyte count in the blood reached  $5.44 \pm 0.36 \times 10^{12}$ /liter, hemoglobin content increased to  $14.72 \pm 0.98$  g/liter compared to  $3.91 \pm 0.26 \times 10^{12}$ /liter and  $13.04 \pm 0.87$  g/liter, respectively, before INH. The increase in erythrocyte count after INH therapy was paralleled by reticulocytosis ( $15.20 \pm 0.23\%$  vs.  $11.03 \pm 0.16\%$  before INH).

The positive clinical effect appeared after 3-4 sessions of INH and stabilized after subsequent sessions. It was more pronounced in patients receiving m INH treatment in combination with drug therapy, which was previously little effective.

Of particular interest was to evaluate the duration of the INH effect. One-two-year follow-up study showed

remissions for at least 1 year in 37.5% patients. Repeated courses of INH after 8-12 months gave more stable and long remissions. In some patients neglecting diets exacerbations developed after diet violations or nervous stresses, but the course of these exacerbations was less severe than usually.

The main factor determining the duration of remission is the initial status depending on functional reserve of the gastrointestinal tract. The duration of remission depended also on the mode and duration of INH treatment. Patients receiving up to 21 INH sessions demonstrated longer remissions.

Our findings and published data confirm the stimulating effect of normobaric hypoxia. The pronounced positive effect in 87% patients suggest that this method can be effectively used in the treatment of PU and that further studies of the sanogenic properties of INH are required. Polymorphic picture of the positive effect of INH observed in this study indicates the involvement of many regulatory mechanisms in the realization of its therapeutic effect.

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