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CASE REPORT

INFLUENCE OF ALTITUDE CHANGES ON A PERSON, WHO UNDERWENT OBESITY TREATMENT WITH INTRAGASTRIC LIQUID FILLED BALLOON

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Abstract: Surgical treatment of obesity has become increasingly popular in recent years. The endoscopic intragastric balloon (IB) placement is often selected as a less invasive procedure compared to operative procedures. Balloon placement may give rise to concerns about gas expansion caused by altitude changes both in the upper part of gastrointestinal tract and in IB itself. The subject presented in this case report underwent placement of a liquid-filled IB and was subjected to hypobaric expositions. Both 7 500 m and 10 000 m hypobaric chamber expositions were successful in terms of management of gas expansion, which led to a conclusion that liquid-filled IB is safe for air passengers and active flying personnel both in normal and emergency situations.

INTRODUCTION

Obesity has become a major problem in today's world. With an increase in its prevalence in the general community, the number of aviator community members suffering from obesity also increases. In spite of traditional solutions like introduction of changes in patients' lifestyle and dietary habits, surgical treatment of obesity has gained increasing attention and interest of patients and medical professionals. The dynamic development of such surgical procedures as bariatric surgery has been observed in the recent years, particularly in terms of effectiveness and patients' safety. However, the procedure still involves risk, including death [3,4,6,7].

This situation gave rise to the introduction of potentially less invasive procedures for obesity treatment with endoscopic placement of intragastric balloons. Usually, intragastric balloon insertion is the first step in surgical treatment of morbid obesity in patients with contraindications for general anesthesia used in bariatric surgery due to existing comorbidities. After body mass reduc-

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tion and at least partial amelioration of comorbidities, patients can undergo the bariatric procedure under general anaesthesia. In the recent years, the use of intragastric balloon (IB) is also considered in less severe cases of obesity as a primary form of therapy [5].

Super-obese patients are unfit for flying duties both due to weight and dimension restrictions of the majority of aircrafts, as well as usual comorbidities of obesity which are contraindications to active flying themselves. However, some cases of obesity, may be considered as fit for flying, especially when there are no signs of developed comorbidities such as: diabetes, improper glucose tolerance or cardiovascular diseases. This may give rise to the idea of obesity treatment in aviators using intragastric balloons.

There are two different types of intragastric balloons used for obesity treatment: gas-filled and liquid-filled. The gas-filled balloons seem to be better tolerated by patients than the liquid-filled balloons. However, the gas-filled balloons are contraindications to flying duties due to a potential problem associated with gas expansion during the increase of altitude. Therefore the liquid-filled intragastric balloon seems to be more suitable for flying, and a worse tolerance of this type of balloon by patients may not necessarily be true, as it was shown in the described case. For the time being, there is no comparative data on patients' tolerance for both types of IB. The intragastric balloon placement procedure carried out in one of the authors gave rise to the idea of testing the influence of one of aviation environmental factors on patients with liquid-filled intragastric balloons.

CASE REPORT

The subject described is a white male, 40 years old, 194 cm tall, with body mass of 147 kg and BMI of 39.1 kg/m2. Laboratory results revealed impaired fasting glucose – 126mg/dL, elevated triglyceride level – 232mg/dL and low HDL level – 31mg/dL. The subject was qualified to IB insertion which took place in November 2010. The insertion was carried out in short-term i.v. anesthesia and was uneventful. The ORBEA system was used with 600 mL of methylene blue water solution. After occurrence of symptoms typical for IB insertion, like nausea, vomiting and minor abdominal pain which took around 4 days, the subject returned to his professional duties. Part of these duties included aeromedical

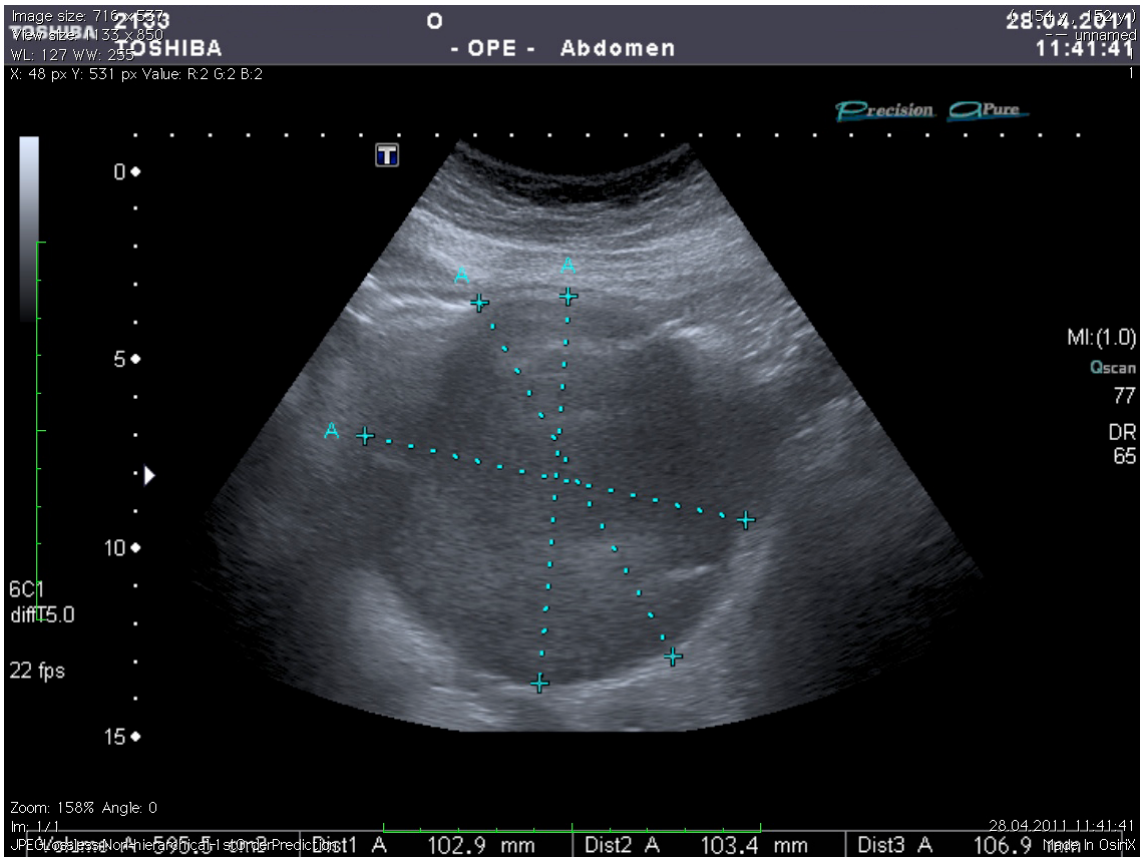

Fig. 1. Ultrasound examination of the stomach presenting liquid-filled balloon properly placed with no residual air.

training of flight personnel in hypobaric chambers according to NATO STANAG 3114.

The subject has more than 10 years of experience in hypobaric expositions both as a leading physician (outside the chamber, supervising expositions) and as an inside instructor assisting and supervising flight personnel undergoing aeromedical training inside the chamber. Hypobaric expositions described in this paper were carried out as a part of regular professional duties, therefore the author did not require ethics committee approval. Also pressure profiles applied were standard, used for training, not experimental.

Hypothetically, a properly filled balloon of liquid type should not contain air inside. However, this cannot be guaranteed, even in normal cases of obesity treatment. A small air residue in the balloon is not important from the point of view of therapy. To assess possible presence of air in IB, the subject underwent abdominal ultrasound examination, which revealed no residual air trapped in the balloon.

After the absence of air residue in IB was confirmed, the subject went to a hypobaric chamber first as a trainee, with other instructor inside. Hypobaric exposure was carried out according to aeromedical training instructions and included 30 min of preoxygenation, ear and sinus check at 3 000 m and at 7 500 m above sea level – see Fig. 2. Baseline altitude was 115 m AMSL – ground level of hypobaric chamber.

During exposition the subject did not have any adverse effects with altitude increase. Venting of expanding gases from the upper gastrointestinal tract was also unproblematic. Encouraged with the results of the first exposition, the subject took part also in exposition of type II. This exposition is used for HALO-HAHO parachute personnel. The main difference as compared to type I regarding only the demonstration of hypoxia effects was the decompression sickness susceptibility test – fast ascent from 7 500 m to 10 000 m: ascent at 50 m/s, followed by 1 minute of stay at 10 000 m, and descent at 50m/s to 7 500 m. That chamber run underwent without problems as well, with venting of expanding GI tract gases.

The subject underwent in total 6 expositions of type I and 2 expositions of type II during the period of IB therapy. Each of the chamber runs was uneventful. Subsequently, after therapy the balloon was removed in June 2011. The removal procedure was carried out under short-term iv. anesthesia and was uneventful.

The therapeutic goals were achieved with the following results: body mass of 117 kg, body mass index - 31.1 kg/m2 , fasting glucose - 86 mg/dL, triglyceride level – 157 mg/dL and HDL level – 41 mg/dL.

DISCUSSION

The majority of flight personnel is able to maintain proper body weight. However, there is a visible tendency towards an increase in military and especially civilian flight personnel population with BMI levels ranging from 38 to 40. One of possible methods of treatment, supporting diet and change of lifestyle, is the use of intragastric balloons [8]. Experience gained in the described

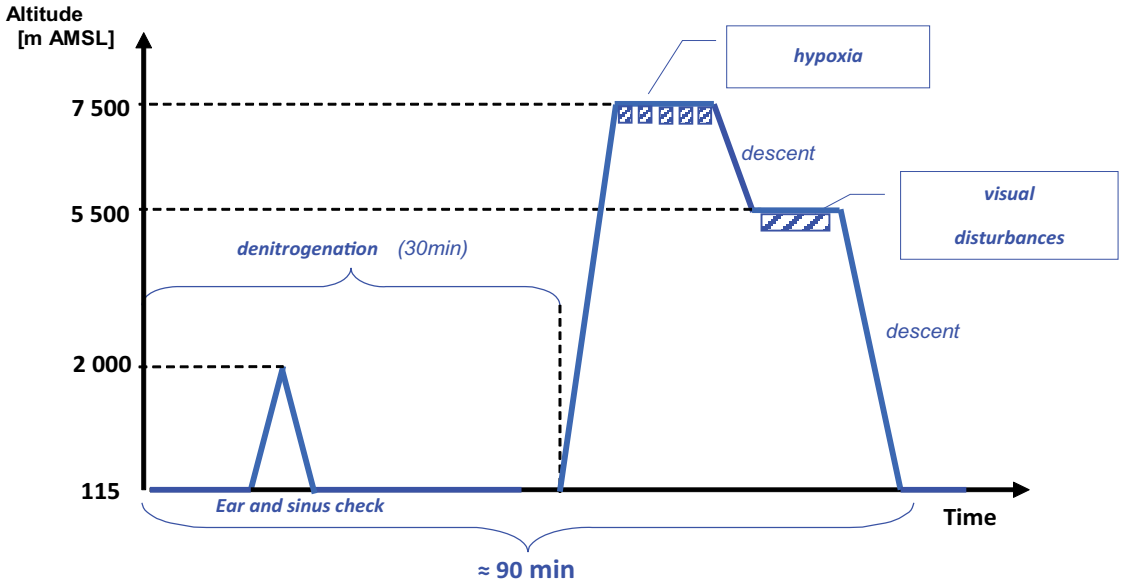

Fig. 2. Hypobaric exposition profile of type I.

expositions allows us to assume that intragastric balloon therapy with dietary management may be of value in certain groups of flight personnel with early stages of obesity, prior to emergence of other obesity-related health issues [2].

After confirmation that IB does not contain air, we focused on the possibility of release of the expanding gas from the upper gastrointestinal tract, which normally, in individuals without IB, does not cause any problems. During hypobaric expositions it became apparent that balloon, although closely "fitted" in the stomach, does not cause any problems with expanding gas evacuation even in the last part of type II hypobaric ascent (7 500 to 1 000 m, 50 m/s).

Another consideration is passenger safety during IB treatment. Parameters of hypobaric expositions described in this paper were above pressure changes during normal commercial flights, and exposition of type II exceeds even the cabin altitude after airliner decompression, which are widely accepted in safety system designing.

Certainly, all the above presented data are valid only for liquid-filled balloons. Air- and gas-filled balloons are inherently incompatible with great pressure changes because of the risk of both balloon and stomach damage. Taking into consideration similar therapeutic efficiency [1], liquid-filled balloons should be considered as the only way of therapy both in flight personnel and in patients who fly a lot. Taking into account the results presented in this paper we would like to emphasize the following:

- Prior to aeromedical disposition, liquid-filled balloon must be ultrasound examined for any residual air left after placement procedure. Only air-free IB should be considered as safe for hypobaric exposures and therefore also for active flying duties;
- Intragastric liquid-filled balloon seems to be compatible with flying duties, provided that there are no other health problems precluding fitness to flight;
- Airline passengers with intragastric liquid-filled balloons are safe in terms of the influence of cabin pressure changes both in normal and in emergency conditions.

AUTHORS' DECLARATION:

Study Design: Krzysztof Kowalczuk, Mariusz Wyleżoł; **Data Collection:** Krzysztof Kowalczuk, Mariusz Wyleżoł; **Manuscript Preparation:** Krzysztof Kowalczuk, Mariusz Wyleżoł; **Funds Collection:** Krzysztof Kowalczuk, Mariusz Wyleżoł. The Authors declare that there is no conflict of interest.

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