Intragastric balloon as a bridging therapy in children and adolescents before orthopedic surgery

Original Article

Mohamed H. Soliman[a], Tarik Barakat[b], Ahmad S. Aly[c] and Mohammed Abdel-Latif[d]

Department of [a]Pediatric Surgery, [c]Orthopedic Surgery, Faculty of Medicine, Ain-Shams University, Cairo, [b]Pediatrics, Faculty of Medicine, Mansoura University, Mansoura. [d]Pediatric Surgery, Faculty of Medicine, Helwan University, Cairo, Egypt.

ABSTRACT

Background: Intragastric balloons (IGB) offer a less invasive solution for obesity. The current work aimed to test the feasibility of IGB as a bridging therapy in old children and adolescents with obesity before orthopedic surgery.

Patients and Methods: A retrospective review of medical records was performed from January 2021 to December 2022. Included patients were old children and adolescents with body mass index (BMI) greater than or equal to the 95th percentile for age and sex in association with orthopedic pathology. They were managed by endoscopic guided insertion of IGB.

Results: Eleven males and seven females were enrolled. Their mean age was 127/12 years (±1 3/12 SD). Before IGB, their mean BMI percentile was 98.88 (±0.56 SD). The mean operative time was 28.28 min (±3.64 SD). At the time of balloon retrieval, eight patients were below the 95th percentile for age and sex, three patients reached the 95th percentile, while seven patients remained above the 95th percentile. There was a significant difference between the mean values of BMI and percentiles before and after IGB (*P value <0.001*).

Conclusion: IGB can serve as a bridging therapy for children and adolescents with obesity before orthopedic surgery, facilitating the restoration of their regular physical activity levels.

Key Words: Adolescents, intra gastric balloon, orthopedic surgeries.

Received: 21 March 2024, **Accepted:** 8 April 2024, **Published:** 4 October 2024

Corresponding Author: Mohamed Hisham Soliman, MD, Department of Pediatric Surgery, Faculty of Medicine, Ain-Shams University, Cairo, Egypt. **Tel.:** 01000706394, **E-mail:** mohamed.hisham.soliman@gmail.com

ISSN: 1110-1121, October 2024, Vol. 43, No. 4: 1163-1167, © The Egyptian Journal of Surgery

INTRODUCTION

Obesity is an increasingly prevalent and chronic disease characterized by a bodyweight exceeding the recommended range for a given height. In the childhood period, obesity is related to age and sex. Several factors, such as genetic, behavioral, psychological, socioeconomic, and environmental, affect children and their families and contribute to the occurrence of obesity in childhood[1]. Obesity affects the children's quality of life passively through its adverse impact on health. In the same context, it has been observed that obesity has an adverse impact on the health of bones and joints[2].

Intragastric balloons (IGB) offer a temporary, minimally invasive solution for obesity. They reduce weight through their mechanical and metabolic effects on the stomach[3]. IGB can be used as a viable solution for addressing the therapeutic gap and providing management for individuals with overweight or obesity who are ineligible for bariatric surgery[4].

This study aimed to assess the viability of utilizing an IGB as a bridging therapy for old children and adolescents with obesity undergoing orthopedic surgery.

PATIENTS AND METHODS:

A retrospective review of medical records from January 2021 to December 2022 was performed in Ain Shams University Hospitals. Included patients were children and adolescents suffering from obesity and presented with orthopedic pathology. The Orthopedic Department referred them to the Pediatric Multidisciplinary Nutrition Clinic for weight reduction before the surgical repair of their orthopedic pathology. Patients were managed by endoscopic guided insertion of IGB.

Inclusion criteria

(a) Age: ranging from 9 to 16 years.

(b) Body mass index (BMI) greater than or equal to 95th percentile for age and sex.

(c) Inability to lose weight through conventional dietary plans of weight reduction.

Exclusion criteria

(a) Patients suffering from endocrinal or upper gastrointestinal diseases.

DOI: 10.21608/EJSUR.2024.278050.1031

(b) Patients with a history of weight control surgical procedures.

Preoperative preparation included a complete blood count, bleeding profile, serum electrolytes, liver function tests, kidney function tests, thyroid profile, lipid profile, serum glucose level, HbA1c level, and abdominal ultrasound.

Balloon insertion

The patients were placed in a supine position. A comprehensive examination of the esophagus, stomach, and first part of the duodenum was performed by upper gastrointestinal endoscope size 11 under general anesthesia. IGB was inserted and advanced carefully into the stomach after removing the scope. The scope was then reinserted to ensure the balloon was positioned just below the cardia in the stomach. Under visual inspection, 550–600 ml of normal saline and 10 ml3 of 4% methylene blue were used to inflate the balloon. The filling catheter was subsequently detached from the balloon.

Follow-up

All the patients were observed in the ward for 4–6 h to monitor their vital data and test their tolerance for clear oral fluids. They were discharged on a liquid diet for 7 days. Patients started a semisolid diet on the 8th day and continued for 7 days. The introduction of solid food commenced on the 15th day. The progression of the regimen was individualized based on the tolerance level of each patient while ensuring that the maximum daily caloric intake was 1300 kcal/day.

All patients were prescribed an antiemetic (metoclopramide) for a week. A full dose of proton pump inhibitor was written down for a month. Subsequently, the dose was reduced to half throughout the period of IGB presence. Antispasmodics and analgesics were prescribed as needed.

The first clinic visit was held 1 week after IGB insertion to assure tolerance for oral intake and monitor any complications. Monthly visits were scheduled for all the patients until balloon retrieval. The lipid profile, serum glucose, and HbA1c levels were reassessed at 3 and 6 months following the balloon insertion.

The balloon was kept intragastric for a period ranging from 6 to 9 months, as determined by the percentage of excess weight loss (%EWL). The primary objective was to achieve 50% EWL. The percentage of excess weight loss was calculated after a 6-month period. The balloon was retrieved if %EWL was greater than or equal to 50%. If the target was not reached after 6 months, the patient was followed-up monthly for 3 months until he lost 50% of his excess weight. The balloon was retrieved either upon successful completion of the objective or after a 9-month period, regardless of whether the aim was not fulfilled. Following the retrieval of the balloons, all patients underwent a monthly follow-up for 3 months before being referred back to the orthopedic clinic.

Balloon retrieval

Patients were kept on clear oral fluids for 24 h before the time of balloon retrieval. IGB was removed with the aid of esophageal endoscopy under general anesthesia. A special needle catheter was used to deflate the balloon under vision. The ruptured balloon was gripped utilizing an endoscopic grasper to be delivered through the mouth.

Anthropometric measurements

Height and weight: The Centers for Disease Control and Prevention (CDC) BMI Percentile Calculator for children and teens[5] was used to calculate BMI, BMI percentile, and percent of the 95th percentile. The patients were classified according to the criteria established by CDC[6] and the research conducted by Skinner and Skelton[7], as depicted in (Table 1).

Total weight loss (TWL) and percent of weight loss (%WL).

Percent of excess weight loss (%EWL): It was calculated in relation to the 50th percentiles for age and sex[8]. Patients who achieved %EWL greater than or equal to 50% were considered highly successful. In contrast, patients who lost greater than or equal to 20% but less than 50% were deemed successful. The management was considered a failure If %EWL was less than 20%.

Table 1: Classification of overweight and obesity

Category	BMI percentile for age and sex
Overweight	≥85th percentile but <95th percentile
Obesity	≥95th percentile
Severe obesity	≥120% of the 95th percentile
Subcategories of severe obesity	
Class 2 obesity	≥120% of the 95th percentile but <140% of the 95th percentile
Class 3 obesity	≥140% of the 95th percentile

Data management and analysis

The collected data was revised, coded, tabulated, and introduced to a PC using Statistical Package for Social Science (SPSS 25). Data was presented, and suitable analysis was done according to the type of data obtained for each parameter.

(a) Mean, SD (±SD), and range were used for numerical data.

(b) Frequency and percentage were applied for categorical data.

(c) Paired t test was used to assess the statistical significance of the difference between two means measured twice for the same study group. The *P value* was considered significant if it was less than 0.05.

RESULTS:

A total of 18 patients were enrolled during the designated study period, as indicated in (Table 2). The sample consisted of 11 males and 7 females. The youngest individual in the sample had an age of 9 1/12 years, whereas the oldest individual was 14 10/12 years old (mean: 12 7/12 years±1 3/12 SD). A total of 10 patients presented with neglected untreated infantile Blount's disease, necessitating surgical intervention. Additionally, five patients exhibited slipped capital femoral epiphysis, while three patients had fracture malunion that required surgical correction.

Two cases were obese, while 16 were severely obese (14 were 'Class 2 Obesity' and two were 'Class 3 Obesity'). The mean BMI was 32.24 kg/m^2 (±1.13 SD). All patients were above the 95th percentile for their age and sex. The mean percentile was 98.88 (±0.56 SD). The mean percentage of the 95th percentile was found to be 128.5% (±8.02 SD). There were no morbid conditions hitting the criteria for surgical sleeve gastrectomy. Enrolled cases did not respond to conventional weight reduction diet plans.

Enrolled patients were managed by IGB insertion under general anesthesia. The mean operative time was 28.28 min (±3.64 SD). There were no recorded intraoperative complications. All patients were discharged within a timeframe of 4–6 h after achieving recovery.

Thirteen patients exhibited favorable tolerance for IGB with no significant incidence of intractable vomiting or feeding intolerance. Five cases complained of daily attacks of nausea and/or vomiting related to meals. Ondansetron was implemented as an adjunct antiemetic to manage nausea and vomiting. The patients experienced improvement within a period of 11 days following their surgical procedure. There were no reported cases of gastric ulcers or spontaneous balloon deflation.

During the time of balloon retrieval, 10 patients were obese, and eight patients were overweight. The mean BMI was 25.1 kg/m^2 (±0.93 SD). Eight patients were below the 95th percentile for age and sex, while three patients reached the 95th percentile. Seven patients remained above the 95th percentile. Their mean percentage of 95th percentile was 105.71% (±4.56 SD). There was a significant difference between the mean values of BMI and percentiles before and after IGB (*P value <0.001*).

The mean TWL was 17.17 kg (±1.04 SD). The mean %WL was 22.14% (±1.4 SD). The mean %EWL was 51.54% (±6.96 SD). Eleven (61.1%) patients achieved greater than or equal to 50% EWL, five patients after 6 months from IGB insertion, two patients after 7 months, and four patients after 8 months. The highest %EWL was 66.2%. Seven patients could not reach the main treatment goal. The lowest %EWL was 40%.

Table 2: Data of enrolled cases

No	Sex	Age		Before balloon			Duration of balloon (months)	After balloon		
		Years	Months	Weight (Kg)	BMI	% of 95th percentile		Weight (Kg)	BMI	% of 95th Percentile
1	M	14	1	82	32.03	123	7	63	24.61	
2	M	11	5	76	31.63	134	9	60	24.97	106
3	F	13	8	77	33.33	124	7	58	25.1	
4	F	12		72	32	127	6	56	24.89	
5	M	10		73	32.88	148	8	55	24.77	112
6	M	14	3	80	30.48	116	6	63	24.01	
7	M	13		78	31.24	124	7	61	24.44	
8	F	14		80	34.63	127	8	64	27.7	102
9	M	9	9	71	31.98	146	9	55	24.77	113
10	F	11	7	72	32.87	133	6	54	24.65	
11	F	13		79	34.19	130	7	62	26.84	102

12	M	13	2	83	31.24	123	9	65	24.46	
13	M	12	10	81	31.64	126	8	64	25	
14	F	13		76	30.83	117	8	60	24.34	
15	M	13	5	85	33.62	132	7	67	26.5	104
16	F	12		74	32.03	127	8	57	24.67	
17	M	12	4	82	31.63	129	9	64	24.69	101
18	M	13	2	77	32.05	127	8	61	25.39	

DISCUSSION

Obesity has detrimental effects on the growing skeleton, thereby potentially leading to long-term implications. Excess body weight has a negative impact on bone quality and is associated with site-specific fractures due to increased mechanical stress in some bony areas[9]. In their study, Messier *et al*. [10] illustrated that a reduction of one unit of weight leads to a fourfold decrease in the pressure exerted on each knee per step. There is evidence that patients with obesity are more liable to perioperative complications in orthopedic surgery than patients with normal weight[11,12]. In addition, revision rates are higher among patients with obesity[13].

Blount disease is a developmental disorder that exhibits a significant correlation with pediatric obesity. The condition is distinguished by the involvement of the posteromedial region of the growth plate located in the proximal tibia[14]. Slipped capital femoral epiphysis is a prevalent condition observed in the adolescent population, characterized by the displacement of the proximal femoral epiphysis. The excessive load imposed on the growth plate due to increased body weight contributes to the deterioration of the developing physic[15]. The outcome of conservative management of fractures is inversely affected by obesity. Children with obesity and fractures are more liable to displacement after conservative management. Therefore, they should be followed-up closely[16].

The current study included old children and adolescents with orthopedic pathology. They were either obese, class 2 obesity, or class 3 obesity according to the percentiles of their matched age and sex. Their excess weight resulted in postponing their orthopedic surgery or postconservative management complications. The outcome of dietary manipulations was passively influenced by the restricted physical activity resulting from their underlying orthopedic pathology. Endoscopic-assisted IGB was performed on all of them, aiming to reduce 50% of their excess weight.

Prior to the IGB insertion, patients and their caregivers participated in multidisciplinary clinic visits to ensure they were well-informed about the management plan, its objectives, and the various stages involved. During the scheduled visits, the potential complications associated with IGB were deliberated, with particular emphasis on the likelihood of weight regain following its removal. Patients exhibited a strong inclination to recommence physical activity in accordance with the orthopedic regimen, as well as diligently adhering to the dietary plan subsequent to the removal of IGB.

Although no patient gained his/her normal weight for age and sex, all patients had their obesity category improved. All patients who were less than 120% of their 95th percentile and ≈ 64.3% of patients with class 2 obesity achieved the treatment goal. None of the patients with class 3 obesity obtained 50% EWL.

The results of the current study were comparable to a study conducted on 27 adolescents with BMI greater than 97th percentile for age[17]. After using IGB for 6–7 months in the aforementioned study, the mean %EWL was found to be 56.94%, the mean TWL was 15.99 kg, and the mean %WL was 16.35%. In the current study, the mean %EWL was 51.54%, the mean TWL was 17.17 kg, and the mean %WL was 22.14%. In their systematic review and meta-analysis, Saber and colleagues concluded that the use of IGB in conjunction with lifestyle modifications proves to be efficacious in achieving short-term weight loss among specific patient populations[18].

In the majority of patients (72.2%), IGBs were retained for prolonged durations ranging from 7 to 9 months. Approximately 38.9% of patients reached the maximum period of 9 months. However, none of them could achieve a 50% loss of their excess weight. There were no complications related to the extended period of IGB, which may be attributed to the study's small sample size.

IGB proved to be beneficial in short-term weight loss. The long-term outcome after the retrieval of IGB is controversial. Most studies demonstrated limitations in the sustainability of weight loss over time[4]. The current study is limited by its retrospective nature, small number of patients, and short follow-up period.

CONCLUSION

The current study findings demonstrated that IGB is well-tolerated and safe for pediatric patients. It serves as a beneficial bridging therapy for children and adolescents with obesity before orthopedic surgery, facilitating the restoration of their regular physical activity levels. For optimal results, perioperative counseling, lifestyle modifications, and dietary adjustments are required.

CONFLICT OF INTEREST

There are no conflicts of interest.

REFERENCES

1. Hampl SE, Hassink SG, Skinner AC, *et al*. Clinical practice guideline for the evaluation and treatment of children and adolescents with obesity. Pediatrics. 2023; 151:e2022060640.

2. Smith SM, Sumar B, Dixon KA. Musculoskeletal pain in overweight and obese children. Int J Obes (Lond) 2014; 38:11–15.

3. Cho JH, Bilal M, Kim MC, Cohen J, Study group for endoscopic bariatric and metabolic therapies of the Korean society of gastrointestinal endoscopy. The clinical and metabolic effects of intragastric balloon on morbid obesity and its related comorbidities. Clin Endosc. 2021; 54:9–16.

4. Lari E, Burhamah W, Lari A, Alsaeed T, Al-Yaqout K, Al-Sabah S. Intra-gastric balloons - The past, present and future. Ann Med Surg (Lond) 2021; 63:102138.

5. Centers for Disease control and Prevention, BMI Percentile Calculator for Child and Teen. https://www.cdc.gov/healthyweight/bmi/calculator.html, Accessed October 17, 2023

6. Centers for Disease control and Prevention, Defining Child BMI Categories. https://www.cdc.gov/obesity/basics/childhood-defining.html, Accessed October 17,2023

7. Skinner AC, Skelton JA Prevalence and trends in obesity and severe obesity among children in the United States, 1999-2012. JAMA Pediatr. 2014; 168:561–566.

8. Centers for Disease control and Prevention, Data Table of BMI-for-age Charts. https://www.cdc.gov/growthcharts/html_charts/bmiagerev.htm, Accessed October 17, 2023

9. Shapses SA, Pop LC, Wang Y. Obesity is a concern for bone health with aging. Nutr Res 2017; 39:1–13.

10. Messier SP, Gutekunst DJ, Davis C, DeVita P. Weight loss reduces knee-joint loads in overweight and obese older adults with knee osteoarthritis. Arthritis Rheum 2005; 52:2026–2032.

11. London DA, Stepan JG, Lalchandani GR, Okoroafor UC, Wildes TS, Calfee RP. The impact of obesity on complications of elbow, forearm, and hand surgeries. J Hand Surg Am 2014; 39:1578–1584.

12. Ubillus HA, Samsonov AP, Azam MT, Forney MP, Jimenez Mosquea TR, Walls RJ. Implications of obesity in patients with foot and ankle pathology. World J Orthop 2023; 14:294–301.

13. Chaudhry H, Ponnusamy K, Somerville L, McCalden RW, Marsh J, Vasarhelyi EM. Revision Rates and Functional Outcomes Among Severely, Morbidly, and Super-Obese Patients Following Primary Total Knee Arthroplasty: A Systematic Review and Meta-Analysis. JBJS Rev 2019; 7:e9.

14. Sabharwal S. Blount disease: an update. Orthop Clin North Am 2015; 46:37–47.

15. Lehmann CL, Arons RR, Loder RT, Vitale MG. The epidemiology of slipped capital femoral epiphysis: an update. J Pediatr Orthop 2006; 26:286–290.

16. Nowicki P, Kemppainen J, Maskill L, Cassidy J. The role of obesity in pediatric orthopedics. J Am Acad Orthop Surg Glob Res Rev 2019; 3:e036.

17. Fittipaldi-Fernandez RJ, Guedes MR, Galvao Neto MP, Klein MRST, Diestel CF. Efficacy of intragastric balloon treatment for adolescent obesity. Obes Surg 2017; 27:2546–2551.

18. Saber AA, Shoar S, Almadani MW, *et al*. Efficacy of first-time intragastric balloon in weight loss: a systematic review and meta-analysis of randomized controlled trials. Obes Surg 2017; 27:277–287.