Published in final edited form as:

Surg Obes Relat Dis. 2017 January ; 13(1): 41–44. doi:10.1016/j.soard.2015.11.029.

Weight loss surgery improves quality of life in pediatric patients with osteogenesis imperfecta

Augusto Zani, M.D., Ph.D.^{1,2}, Martha Ford-Adams, M.R.C.P., F.R.C.P.Ch.¹, Megan Ratcliff, Ph.D.³, Denise Bevan, D.Clin.Psy.⁴, Thomas H. Inge, M.D., Ph.D., F.A.C.S., F.A.A.P.³, and Ashish Desai, M.Ch., F.R.C.S. (Paeds)¹

¹King's College Hospital, London, United Kingdom

²The Hospital for Sick Children, Toronto, Canada

³Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio, USA

⁴South London & Maudsley Trust, London, United Kingdom

Abstract

Background—Osteogenesis imperfecta (OI) is an inherited disorder, which causes brittle bones resulting in recurrent fractures. The associated poor mobility of children with OI increases susceptibility to obesity, and obesity further dramatically limits mobility and increases fracture risk.

Objectives—The aim of this report was to describe outcomes of weight loss surgery (WLS) in two adolescents with severe obesity and OI.

Setting—Two University Hospitals (in the United Kingdom and in the United States).

Methods—Two cases of OI treated with WLS were identified. Pre- and post-operative anthropometric and biochemical data and clinical course were reviewed.

Results—In these 2 cases, preoperative Body Mass Index (BMI) values were 38 and 46 kg/m². Following laparoscopic sleeve gastrectomy (LSG), BMI decreased by 55% and 60% by 26 and 24 months, respectively. There were no surgical complications and both patients experienced improvement in their mobility and ability to perform activities of daily living.

Conclusions—WLS effectively treated severe obesity in two OI patients and substantially improved mobility and quality of life, theoretically reducing fracture risk.

Corresponding Author: Ashish Desai, MCh, FRCS (Paeds), Consultant Pediatric Surgeon, King's College Hospital, London SE5 9RS, UK, ashishdesai@nhs.net, Telephone: 00442032993350, Fax: 00442032994021.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Conflict of Interest:

TI receives research support from Ethicon Endosurgery, not pertaining to this work.

Disclosures:

None.

Keywords

osteogenesis imperfecta; child; pediatric; obesity; quality of life; weight loss surgery; brittle bone; laparoscopic; sleeve gastrectomy

Introduction

Osteogenesis imperfecta (OI), also known as brittle bone disease, is a genetic disorder characterized by low bone mass with high susceptibility to bone fractures ⁽¹⁾. Patients with OI are born with defective connective tissue, that in 90% of cases is due to heterozygous mutations in one of the two type I collagen genes, COL1A1 and COL1A2 ⁽²⁾. The different types of mutations produce different types of clinical presentations that range from being asymptomatic with mild predisposition to fractures to severely disabled or even perinatal death ^(1,2).

Patients with OI have a nutritional status, bone mineral density, and dietary requirements different from the normal population ⁽³⁾. Some children and adults with OI might experience obesity as a result of lack of physical activity, small body size and high calorie diet. In these patients, obesity impedes mobility, puts additional stress onto weak bones and increases the risk of diabetes and hypertension.

Behavioral-based dietary and physical activity interventions offer little benefit for pediatric obesity, while pharmacologic therapy is limited and carries low success rates and recidivism ⁽⁴⁾. In the last decade, Weight loss surgery (WLS) has become more widely accepted and utilized as an effective treatment option in reducing body mass index in children and adolescents ⁽⁵⁾.

The aim of the present study was to evaluate the effectiveness of WLS as a treatment of severe obesity in pediatric patients with OI who were burdened by the excess weight and were unsuccessful with conservative treatment.

Methods

Following ethical approval, the clinical databases of two institutions were searched and the case notes of patients with OI and obesity who underwent WLS were retrieved. This series represents the only two patients with OI who had ever undergone laparoscopic sleeve gastrectomy (LSG) for weight management at these 2 institutions. Data collection included preoperative management, type of weight loss surgery, pre- and postoperative anthropometric data (body weight, Body Mass Index (BMI), Z-scores and umbilical waist circumference (UWC)), blood pressure measurements, liver function tests, liver US scans, and biopsy and intra- and postoperative complications. Psychological well-being was assessed using Impact of Weight on Quality of Life - Kids (IWQOL - Kids) subscales (Physical Comfort, Body Esteem, Social Life, Family Relations) and Total scores ⁽⁶⁾, Beck Anxiety Inventory (BAI) ⁽⁷⁾ or Beck Depression Inventory (BDI-II) Total score ⁽⁸⁾, and self-report of changes in competence with activities of daily living (ADL). Data were expressed as median (range).

Results

Patient 1

A 13-year-old boy with OI type III was referred by his orthopedic surgeon to the multidisciplinary adolescent obesity clinic at King's College Hospital, London, England. At referral, his weight was 42 kg (BMI= 38.1kg/m²), with an UWC of 96 cm. Preoperative psychological assessment showed an IWQOL-Kids Total score of 78.7/100 and a BAI of 30/63 (= severe anxiety) with frequent panic attacks.

His ability to participate in ADL was very limited; he was wheelchair bound, in diapers, and required a hoist to transfer. He had sustained 99 fractures in the 5 years prior to referral. A structured dietary and physical activity intervention were instituted. This program resulted in weight loss of 2 kg and a BMI reduction to 33.1 kg/m² over a 4 months period. Given minimal results and the patient's inability to maintain this regimen, surgery was offered. Following routine preoperative counseling, he underwent LSG. The post-operative course was uneventful, except for difficult to treat nausea. An esophago-gastroscopy was performed due to persistent nausea at 14 months postoperatively to exclude anatomic and mucosal disease; the study was unremarkable.

At 12 month and 26 month follow up respectively, the BMI was recorded as 17.1 kg/m² and 20.9 kg/m² respectively. UWC was 63 cm and 77 cm, respectively. Nausea has persisted and required hyoscine patch. Recent barium meal confirmed gastroesophageal reflux and antireflux treatment was started.

Postoperative psychological assessment showed a noticeable improvement in psychological well-being, with IWQoL score of 99/100 and a BAI of 4/63 (no anxiety) at 6 month postoperatively. In addition, his ability to participate in ADLs dramatically improved. Despite being still wheelchair bound, he was able to transfer independently, shuffling across the floor on his hands and buttocks; he could stand with support and dress himself as well as play wheelchair football activities that he could not contemplate at his preoperative weight. Postoperatively, the orthopedic team, who has routinely managed the patient, has reported no fractures in the 26-month period.

Patient 2

A 15-year-old girl with OI type III was referred by her primary care provider for consideration of WLS at Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio, USA. Her BMI was 46.3 kg/m² and UWC was 131 cm. She was suffering from obstructive sleep apnea, self-reported history of depression (in remission at baseline with BDI-II Total score 4/63), and impaired ability to participate in ADLs. Her preoperative IWQoL Total score was 75/100 with particularly marked impairment in Physical Comfort (45.8/100). Preoperative impairment in ADLs included the inability to transfer from wheelchair without assistance, and inability to stand upright even with support.

She had also been unsuccessful with sustained weight loss using dietary and physical activity interventions, but her BMI was stable at 46.2 kg/m². Following bariatric referral and preoperative education, the patient was offered LSG that was carried out 6 months after

referral. No anesthetic complications were recorded. The postoperative course was uneventful and the patient was discharged home on day 3 postoperatively.

At 1, 2, 3, and 4 year follow-up, the BMI was recorded as 28.4, 27.7, 30.4, and 31.4 kg/m², respectively. The only gastrointestinal related complaints were constipation and postprandial bloating. Her UAC had reduced from 130 cm preoperatively to 99.3 cm. Her sleep apnea resolved by 1 year follow up as measured by formal polysomnography.

She exhibited significant improvement in psychological well-being from baseline assessment to 6 months postoperatively, with IWQoL Total score 91.7/100 and clinically meaningful improvements as indicated by exceeding minimal clinically important difference scores (i.e., the smallest clinically relevant change a patient perceives) in all domains except Family Relations ⁽⁹⁾. IWQoL scores were maintained at 94-100/100 through 3-year follow-up. BDI-II scores were also maintained in the minimal, non-clinical range (Total score 1-2/63).

Her postoperative ADL also improved, so that she could carry out more activities independently, including transferring autonomously, standing with support, and moving from wheelchair to ground confidently and safely without assistance. Her energy level also improved markedly but chronic back pain was still problematic. In the 4 years since operation, she did have one fracture of a 5th digit of her hand, and 2 rib fractures but none in major long bones and none that required hospitalization or surgery. Her lumbar spine bone mineral density declined modestly over the 4-year period with baseline, 2 year, 4-year z scores of -2.7, -3.0, -3.4 (corresponding to lumbar bone mineral density [in g/cm²] of 0.748, 0.743, and 0.645) [Figure 1 and 2].

Discussion

Our experience demonstrates that WLS can be beneficial and effective in treating obesity in young patients with OI. The main advantages that we observed following WLS in these cases was increased mobility and improved quality of life, as reported by caregivers and the patients themselves. This finding is consistent with the improved ability to engage in physical activity and mobility reported in wheelchair-bound adults following bariatric surgery ^(10, 11). The increased independence perceived by our patients, as well as improvements in body esteem and social life, was associated with improved weight-related quality of life to 15–36 months postoperatively.

Because of the accentuated fracture risk due in OI patients who become obese, effective methods of weight control and reduction are of interest to patients, caregivers, and medical providers alike. While no prior experience with WLS has been published for the OI patient group, our findings and outcomes suggest that WLS may well be considered. The postoperative weight loss was reported as advantageous not just by the patients but also by their caregivers who experienced easier and safer handling of these fragile patients. Furthermore, WLS has proven to be clinically beneficial in improving glucose metabolism and reducing the cardiovascular risk ⁽⁴⁾. Although cardiovascular involvement in OI is rare, some patients develop left-sided heart valve dilatation leading to aortic and mitral

regurgitation⁽¹²⁾. Since morbidity and mortality rates in OI patients undergoing cardiac surgery are reportedly high^(13, 14), the reduction of cardiovascular risk would appear a reasonable advantage for these patients, particularly if suffering from obesity.

Special considerations have to be made when planning obesity treatment for patients with OI. First, the BMI of OI patients needs to be calculated accurately, taking into consideration the patient's past medical and surgical history. On the one hand, OI patients have a bone mass so much lower than that of the normal population that their BMI reflects that of a younger patient. On the other hand, OI patients tend to be shorter than average and might have rods or other metalwork, so that their actual BMI might not be as representative of fat mass as in non-OI patients.

When considering weight loss surgery in patients with OI, LSG seems to offer similar metabolic outcomes as Roux-en-Y gastric bypass (RYGB). The latter procedure, in fact, could be detrimental in OI patients as it is associated with a greater risk of micronutrient malabsorption, due to exclusion of the duodenum and proximal jejunum from the alimentary stream. Calcium is normally absorbed by active transport primarily in the duodenum and through passive paracellular transport in the jejunum and ileum. Any procedure that might result in deleterious effects on calcium absorption may then be more disadvantageous for patients who already have fragile bones, with low bone mineral density. Although we have found no detrimental effect of RYGB on bone mineral density at 1 to 2-year follow-up in our series of non-OI adolescents operated at Cincinnati Children's Hospital⁽¹⁵⁾, it is predictable that even mild hypocalcemia or hypovitaminosis D would be undesirable for OI patients, whose calcium requirements are different from those of the general population. Moreover, the results of our prospective, longitudinal observational study showing high rates of non-adherence to multivitamin therapy in adolescents who have undergone WLS, makes the recommendation of LSG over RYGB even more logical⁽¹⁶⁾. The fact that lumbar bone mineral density in OI cohorts is typically 3-5 standard deviations below norms for age, careful attention to surveillance and medical management of the underlying bone disease is important, especially following bariatric procedures^(17,18).

Thus in summary, LSG may be preferable for OI patients primarily because the emerging literature showing fewer nutrient deficiencies for LSG than RYGB, including some work that has documented progressive increase in bone mineral density, with a direct correlation with vitamin D and an inverse correlation with parathyroid hormone serum levels^(19,20).

Conclusions

Our early results suggest that WLS may have distinct benefits and acceptable adverse effects for adolescents with OI suffering from severe, mobility limiting obesity. LSG was associated with increased mobility, reduced fracture risk, and improvement in weight related quality of life.

Acknowledgments

The project described was supported in part by the Division of Pediatric Surgery at King's College Hospital, London England, in part by the National Institute of Diabetes and Digestive and Kidney Diseases, under Award

Numbers U01DK072493 and UM1DK072493 (Inge), and by the National Center for Advancing Translational Sciences of the National Institutes of Health, under Award Number UL1TR000077. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

The authors are indebted with Anu Paul and Elke Zani-Ruttenstock for their support with data collection, and with Ameet Patel and Catherine Duffy for their clinical contribution.

References

1. Ben Amor M, Rauch F, Monti E, Antoniazzi F. Osteogenesis imperfecta. *Pediatr Endocrinol Rev*. 2013; 10(Suppl 2):397–405. [PubMed: 23858623]
2. Byers PH, Pyott SM. Recessively inherited forms of osteogenesis imperfecta. *Annu Rev Genet*. 2012; 46:475–97. [PubMed: 23145505]
3. Chagas CE, Roque JP, Santarosa Emo Peters B, Lazaretti-Castro M, Martini LA. Do patients with osteogenesis imperfecta need individualized nutritional support? *Nutrition*. 2012; 28(2):138–42. [PubMed: 21795023]
4. Stefater MA, Jenkins T, Inge TH. Bariatric surgery for adolescents. *Pediatr Diabetes*. 2013; 14(1):1–12. [PubMed: 22830534]
5. Kelly AS, Barlow SE, Rao G, et al. Severe obesity in children and adolescents: identification, associated health risks, and treatment approaches: a scientific statement from the American Heart Association. *Circulation*. 2013; 128(15):1689–712. [PubMed: 24016455]
6. Kolotkin RL, Zeller M, Modi AC, et al. Assessing weight-related quality of life in adolescents. *Obesity (Silver Spring)*. 2006; 14(3):448–57. [PubMed: 16648616]
7. Beck AT, Epstein N, Brown G, Steer RA. An inventory for measuring clinical anxiety: psychometric properties. *J Consult Clin Psychol*. 1988; 56(6):893–7. [PubMed: 3204199]
8. Beck, AT., Steer, RA., Brown, GK. Manual for Beck Depression Inventory-II. San Antonio, TX: Psychological Corp; 1996.
9. Modi AC, Zeller MH. The IWQOL-Kids(©): establishing minimal clinically important difference scores and test-retest reliability. *Int J Pediatr Obes*. 2011; 6(2–2):e94–6. [PubMed: 20883106]
10. Wilms B, Ernst B, Thurnheer M, Weisser B, Schultes B. Differential changes in exercise performance after massive weight loss induced by bariatric surgery. *Obes Surg*. 2013; 23(3):365–71. [PubMed: 23093471]
11. Lutrzykowski M. Bariatric surgery in morbidly obese patients in wheelchairs. *Obes Surg*. 2008; 18(12):1647–8. [PubMed: 18438620]
12. Najib MQ, Schaff HV, Ganji J, et al. Valvular heart disease in patients with osteogenesis imperfecta. *J Card Surg*. 2013; 28(2):139–43. [PubMed: 23347109]
13. Moriyama Y, Nishida T, Toyohira H, et al. Acute aortic dissection in a patient with osteogenesis imperfecta. *Ann Thorac Surg*. 1995; 60(5):1397–9. [PubMed: 8526634]
14. Wong RS, Follis FM, Shively BK, Wernly JA. Osteogenesis imperfecta and cardiovascular diseases. *Ann Thorac Surg*. 1995; 60(5):1439–43. [PubMed: 8526654]
15. Inge, T., Garcia, V. Bariatric Surgery – principles. In: Spitz, L., Coran, AG., editors. *Operative Pediatric Surgery*. New York: Hodder Arnold Publication; 2006. p. 1060–7.
16. Modi AC, Zeller MH, Xanthakos SA, Jenkins TM, Inge TH. Adherence to vitamin supplementation following adolescent bariatric surgery. *Obesity (Silver Spring)*. 2013; 21(3):E190–5. [PubMed: 23404956]
17. Salehpour S, Tavakkoli S. Cyclic pamidronate therapy in children with osteogenesis imperfecta. *J Pediatr Endocrinol Metab*. 2010; 23(1–2):73–80. [PubMed: 20432809]
18. Engelbert RH, Uiterwaal CS, van der Hulst A, Witjes B, Helders PJ, Pruijs HE. Scoliosis in children with osteogenesis imperfecta: influence of severity of disease and age of reaching motor milestones. *Eur Spine J*. 2003; 12(2):130–4. [PubMed: 12709850]
19. Gehrler S, Kern B, Peters T, Christoffel-Courtin C, Peterli R. Fewer nutrient deficiencies after laparoscopic sleeve gastrectomy (LSG) than after laparoscopic Roux-Y-gastric bypass (LRYGB)-a prospective study. *Obes Surg*. 2010; 20(4):447–53. [PubMed: 20101473]

20. Ruiz-Tovar J, Oller I, Priego P, et al. Short- and mid-term changes in bone mineral density after laparoscopic sleeve gastrectomy. *Obes Surg.* 2013; 23(7):861–6. [PubMed: 23315187]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Figure 1.
Postoperative lumbar dual-energy X-ray absorptiometry (DXA) of Patient 2 at the age of 20 years. (L = Lumbar Spine)

Figure 2.

Serial dual-energy X-ray absorptiometry (DXA) scans of Patient 2 before (age 16 years) and after (all subsequent age points) surgery. The graph shows a modest decline in her lumbar spine bone mineral density over a 4-year period. (BMD = Bone Mineral Density)