Laparoscopic-assisted lumboperitoneal shunt insertion with concomitant sleeve gastrectomy in obese patients with idiopathic intracranial hypertension: a retrospective comparative study with promising results

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Received: 30 January 2023
Revised: 2 March 2023
Accepted: 13 March 2023
Published: 9 June 2023

The Egyptian Journal of Surgery 2023, 42:204–211

Background
Lumboperitoneal shunts (LPS) have been described for the management of idiopathic intracranial hypertension (IIH). However, it is not a definitive treatment option for that disease. As IIH is strongly associated with obesity, laparoscopic sleeve gastrectomy (LSG) could be a promising option for IIH patients. Our study aimed to assess the safety and efficacy of the concomitant laparoscopic-assisted LPS and LSG, and to compare it to laparoscopic-assisted LPS alone in the management of obese patients with IIH.

Patients and methods
Thirty obese IIH patients were included in our retrospective analysis. Group A included 15 patients undergoing concomitant LPS and LSG, while group B included the remaining patients undergoing LPS alone. All patients were followed-up for 6 months with assessments of their manifestations and complications.

Results
Both study groups had comparable preoperative variables. There was a significant prolongation in the operative time in group A. The same group had excellent short-term weight loss. All preoperative manifestations, including headache, visual disturbances, and tinnitus, showed either resolution or significant improvement in both groups. The papilledema grades showed a significant decline in both groups. However, the improvement was more pronounced in group A after 3 and 6 months. The incidence of postoperative complications did not differ between the two groups.

Conclusion
Concomitant LPS and LSG are safe and effective combination for the management of IIH. The former provides early relief of symptoms, while the latter achieves effective and durable weight loss, which has a positive impact on IIH manifestations.

Keywords:
idiopathic intracranial hypertension, lumboperitoneal shunt, sleeve gastrectomy

Egyptian J Surgery 42:204–211

1110-1121

Introduction

Idiopathic intracranial hypertension (IIH) is a rare pathology that predominantly affects the obese female population [1]. It is characterized by an increase in intracranial pressure (ICP) with no abnormalities in either the composition or radiological imaging of the cerebrospinal fluid (CSF) [2,3]. Patients with IIH usually complain of headaches, visual disturbances, and pulsatile tinnitus [4]. Although that disease was previously described as 'benign intracranial hypertension' to distinguish it from malignant etiologies causing increased ICP, its course is not benign at all. The headaches are usually intractable and disabling for most patients. In addition, IIH could lead to permanent visual loss if left untreated because of the associated papilledema and optic nerve atrophy [5].

The management options for that disease include lifestyle changes (weight loss and exercise), medications (diuretics and corticosteroids), and surgery (fenestration of the optic nerve sheath or shunting procedures) [6,7]. Despite the availability of the previous multiple options, they are not definitive in nature, as they provide only symptomatic relief for IIH patients [8]. Moreover, the previously mentioned surgical interventions have their own complications and failure rates [9].

The relationship between obesity and IIH is documented [10–13]. Obesity is associated with

 DOI: 10.4103/ejs.ejs_44_23

increased intra-abdominal and intrapleural pressures. This, in turn, leads to an increased cardiac filling pressure. Consequently, the venous pressure is increased resulting in a significant decline of the venous flow out of the brain and increased ICP [8,14]. Therefore, proper weight reduction could be a promising option for the treatment of this intractable pathology [8,15].

Multiple management options have been described for morbid obesity. However, bariatric surgery, including laparoscopic sleeve gastrectomy (LSG), remains the only effective and durable option for maintaining weight loss [16,17]. As the prevalence of obesity has increased in Egypt (about 40% of adult Egyptians are obese) [18], it is expected to encounter more IIH patients in the Egyptian neurological or neurosurgical settings. Multiple studies have reported that bariatric procedures could be a potential option for the management of IIH [19–21].

After intensive literature research, we did not find any previous studies describing the safety and efficacy of concomitant LSG and lumboperitoneal shunt (LPS) in the management of IIH patients. That was a good motive for us to conduct the current study, which aimed to assess the safety and efficacy of the previous combination and compare it to LPS alone in the management of obese patients with IIH.

Patients and methods

Our study represents a retrospective analysis of 30 patients diagnosed with IIH who were surgically managed, after failure of medical treatment at the Neurosurgery Departments of both Helwan and Tanta Universities in collaboration with the General Surgery Departments of the same universities from June 2020 till June 2022. Data collection started after gaining ethical approval from the local scientific and ethical committee of Helwan University. We collected the data of 15 consecutive obese IIH patients who were managed by LSG and LPS and included in group A. Group B included another 15 patients who were managed by only LPS and had matched age, sex, and BMI to group A. Patients whose BMI was less than 35 kg/m^2 or who had another surgical option for IIH rather than LPS were excluded from our analysis.

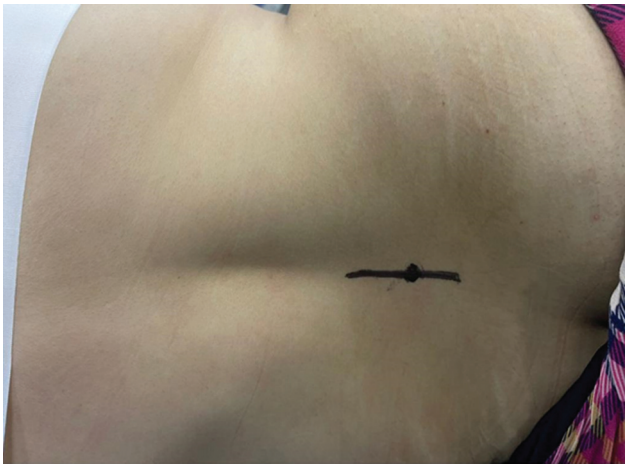
For both study groups, all patients received the standard preoperative evaluation, including history taking (with analysis of IIH-related symptoms), clinical neurological examination, and ophthalmological assessment (including visual acuity testing, perimetry, and a fundoscopic examination for papilledema). Papilledema was graded according to the 'Modified FriseÌ n Scale' [22]. Additionally, lumbar puncture was done for all participants, and the opening CSF pressure was recorded. Furthermore, all patients underwent brain MRI and MR venography to exclude the presence of organic lesions. The diagnosis of IIH was made based on the previous clinical and radiological data.

Patients in group A underwent additional investigations before LSG, including abdominal ultrasonography and esophagogastroduodenoscopy. Routine preoperative laboratory investigations were ordered for both groups prior to the operation.

Regarding the surgical procedure, patients in both groups had LPS in the lateral decubitus position, with their right side on top. We created a small longitudinal midline (Fig. 1) incision (about 2 cm in length) between the spinous processes of lumbar vertebrae 4 and 5. The proximal end of the LPS catheter was introduced into the thecal sac for about 8 cm. Another similar incision was created at the right flank, and the distal end of the LPS catheter was delivered via elastic feeding tube passed with long disc rongeur forceps (Fig. 2).

After that the patients in group A were turned to the French position, five laparoscopic ports were inserted; a supraumbilical one for the camera, two working ports at the right and left midclavicular line, the fourth trocar site for the assistant inserted at the left anterior axillary line and the last one at the same site of the flank incision. The surgeon stands on the patient left side with the monitor screen on the patient right side, then

Figure 1



Performing the midline incision in the lateral decubitus position.

Figure 2

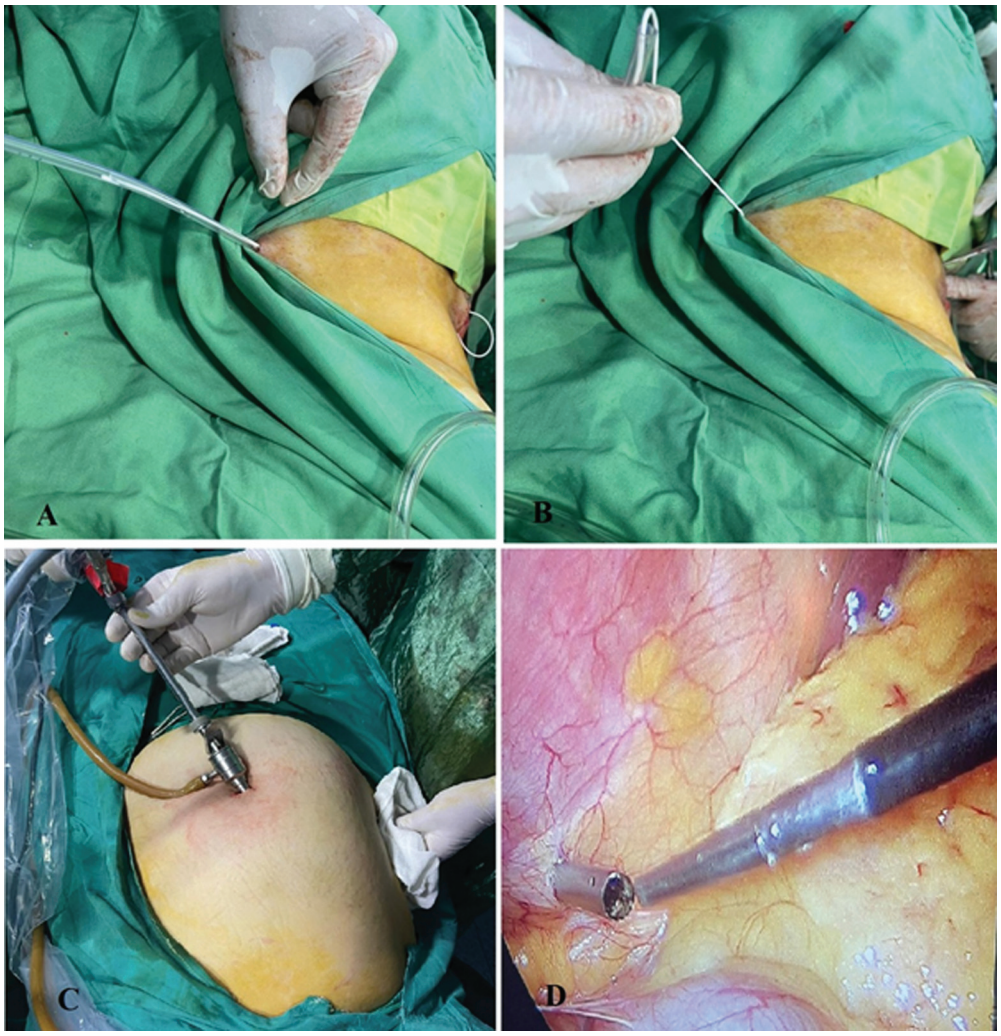
Intraoperative photos showing: (a) lower lumbar midline skin incision opposite L4–5 disc with patient in lateral position and right side up. (b) Insertion of spinal cannula inside the thecal sac then insertion of proximal end of LPS catheter after removal of trocar. (c) Starting of subcutaneous tunneling from midline back to flank incision with disc rongeur forceps. (d) Passage of elastic feeding tube through the tunnel with the distal end of LPS catheter inside. LPS, lumboperitoneal shunt.

a long grasper was inserted through the working port at the left side to exit through the right flank one, and then the distal end of the shunt catheter was grasped into the abdominal cavity, and fixed to the peritoneum by continuous sutures (Figs 3 and 4). After that, the surgeon changed his position to stand in between the patient legs, the first assistant on the right side of the operator and the camera man on his left side.

The LSG was done by devascularization of the greater gastric curve starting 4–6 cm from the pylorus, with division of the short gastric vessels until clear visualization of the angle of His and the left diaphragmatic crus. Then a 40-Fr bougie was inserted for calibration of the newly created gastric tube. Gastric transection was done via an endostapler, starting with green cartridges for the antrum, followed by yellow or blue ones for the remaining stomach. Clipping was done for any bleeding points over the staple line. Additionally, an intraoperative methylene blue test was performed to confirm the integrity of the staple line. The excised stomach was extracted through the largest working port (the left 1.5 cm working port), followed by abdominal desufflation and closure of abdominal wounds.

For group B, four working ports were inserted a supraumbilical one for the camera, two working ports at the right and left midclavicular line, the fourth trocar was inserted at the same site of the flank incision (Fig. 5). Then a long grasper was inserted through the working port at the left side to exit through the right flank one, and then the distal end of the shunt was grasped into the abdominal cavity, and fixed to the peritoneum by continuous sutures. The procedure ended by desufflating the abdominal cavity

Figure 3



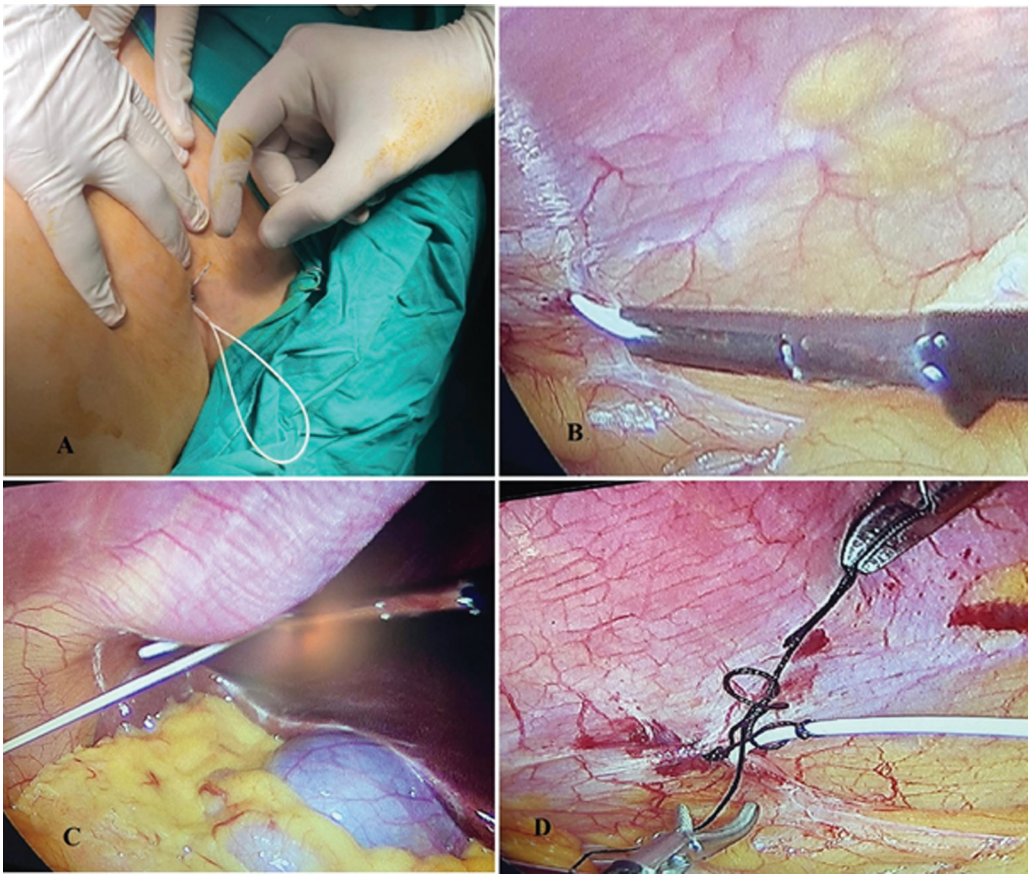
(a) Near complete passage of the feeding tube through the flank incision. (b) Complete passage of the LPS catheter through the flank incision. (c) Midline umbilical camera port and starting of the abdominal stage of procedure. (d) 5 mm trocar introduced through the mini flank incision through which long grasper is passed. LPS, lumboperitoneal shunt.

with closure of all wounds. The previous procedure was performed by the neurosurgeons with the assistance of the general surgeons mentioned in the authors' list of this manuscript.

Patients in both groups were discharged from the hospital on the first or second postoperative day. After removal of skin stitches (2 weeks after the operation), follow-up visits were scheduled for all cases at 1, 3, and 6 months after the operation. Improvement and/or resolution of IIH-related symptoms were recorded. Also, a fundus examination was done, and the papilledema grade was recorded using the same preoperative scale. Any postoperative complications were recorded in both groups, whether related to the shunting (migration, obstruction, or infection) or the LSG (leakage, hemorrhage, or gastric stenosis). For patients in group A, the degree of weight loss, expressed as the percentage of excess weight loss (%EWL) [23], was recorded.

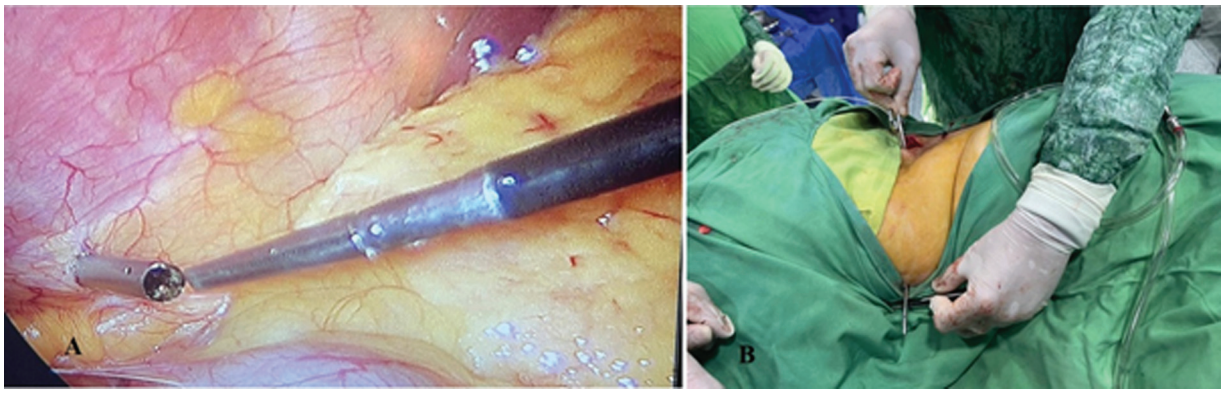
Our data were collected, tabulated, then analyzed via the SPSS software for macOS (IBM SPSS statistics for windows, Version 23.0. Armonk, NY: IBM Corp). We presented our categorical data as numbers (with percentages) and compared between the two groups using the Fisher exact or χ^2 tests. Regarding numerical data, it was presented as mean (with SD) or median (with range). They were compared between the two groups using the Student t test or Mann–Whitney test, respectively, while they were compared within the same group at different time intervals using the paired t test or Wilcoxon signed-rank test, respectively. Any P value less than 0.05 was considered significant.

Figure 4



(a) The catheter was grasped and introduced into the peritoneal cavity under vision. (b) Confirmation that catheter was passed completely to peritoneal cavity. (c) The distal end of catheter was put in dependent hepatorenal recess. (d) Fixation of the catheter in the peritoneal cavity by multiple continuous ligatures.

Figure 5



(a) Laparoscopic view showing the site of the right flank port used to grasp the distal end of the shunt. (b) Exteriorization of the grasper to grasp the distal end of the shunt.

Consent statement

This research was performed at the Department of General Surgery, Helwan University Hospitals. Ethical Committee approval and written, informed consent were obtained from all participants.

Results

Patients in group A had a mean age of 29.47 years, compared to 29.07 years in group B. Their BMI had mean values of 41.12 and 42.12 kg/m^2 in the previous two groups, respectively. Women represented the

Table 1 Basic demographic criteria of patients in the two study groups

	Group A (*N*=15)	Group B (*N*=15)	*P* value
Age (years)	29.47±7.17	29.07±5.99	0.870
Sex [*n* (%)]			0.309
Male	1 (6.67)	0	
Female	14 (93.33)	15 (100)	
BMI (kg/m^2)	41.12±3.73	42.12±3	0.425
Presentation [*n* (%)]			
Headache	15 (100)	15 (100)	1
Visual changes	15 (100)	15 (100)	1
Tinnitus	4 (26.67)	3 (20)	0.666
Papilledema grade	3 (2–4)	3 (2–4)	1
Opening CSF pressure (cmH_2O)	31±4.28	33.47±3.94	0.112

CSF, cerebrospinal fluid.

majority of the study sample, as they constituted 93.33 and 100% of cases in our two groups, respectively. Only one man was included.

Regarding the clinical presentation of the included participants, all of them complained of headaches and visual changes. However, only 26.67 and 20% of patients in groups A and B, respectively, reported tinnitus. Preoperative fundoscopic examination revealed that papilledema grade ranged between two and four in both study groups (median=3). The opening CSF pressure of the included cases had mean values of 31 and 33.47 cmH_2O in the same two groups, respectively. As illustrated in Table 1, the previous parameters were statistically comparable between the two groups.

The combined procedure had significantly longer operative time compared to the single one (143.2 vs. 54.6 min, respectively; $P<0.001$) (Table 2).

LSG was associated with excellent weight loss outcomes. The %EWL had mean values of 12.06, 28.83, and 49.09% 1, 3, and 6 months after the procedure, respectively (Table 3).

All patients in both groups reported either resolution or improvement of their preoperative symptoms after the operation (not shown in the tables).

The degree of papilledema showed a significant decline in both study groups when compared to its corresponding baseline value. Nonetheless, 3- and 6-month assessments revealed the superiority of group A (Table 4).

As shown in Table 5, the incidence of shunt-related complications was statistically comparable between the two study groups. However, all complications in group B required shunt revision, whereas the two migration cases encountered in group A only required the removal of the shunt as the patient reported no symptoms related to an increased ICP. No LSG-related complications were reported in our cases.

Table 2 Operative time in the two study groups

	Group A (*N*=15)	Group B (*N*=15)	*P* value
Operative time (min)	143.20±9.43	54.60±5.29	<0.001**

**Highly significant.

Table 3 The percentage of excess weight loss in group A at follow-up visits

	1 month	3 months	6 months	*P* value
% EWL	12.06 ±2.84	28.83 ±3.21	49.09 ±8.80	*F*=720.265 *P*<0.001**

%EWL, percentage of excess weight loss. **Highly significant.

Table 4 Changes of papilledema grades at follow-up visits

	Group A (*N*=15)	Group B (*N*=15)	*P* value
Preoperative	3 (2–4)	3 (2–4)	0.762
1 month	1 (0–3)	2 (0–4)	0.175
	<0.001**	0.002*	
3 months	0 (0–2)	1 (0–2)	0.048*
	<0.001**	<0.001**	
6 months	0 (0–1)	1 (0–2)	0.022*
	<0.001**	<0.001**	

*Significant. **Highly significant.

Table 5 Postoperative complications in the two study groups.

	Group A (*N*=15) [*n* (%)]	Group B (*N*=15) [*n* (%)]	*P* value
Obstruction	0	2 (13.33)	0.143
Migration	2 (13.33)	1 (6.67)	0.543
Infection	0	1 (6.67)	0.309

Discussion

This is the first study reporting the safety and efficacy of combined LPS and LSG in the management of obese patients diagnosed with IIH. This posed a great advantage in favor of our research. Although multiple studies have proven the effectiveness of bariatric procedures in improving the manifestations of IIH [19–21], that improvement is dependent on weight loss, and it becomes more evident with increased % EWL. That is why we combined the two procedures, to benefit from the rapid effect of LPS, especially that all of our participants had papilledema, as well as the delayed durable effect of LSG, in achieving weight loss.

Our patients had mean ages of 29.47 and 29.07 years in groups A and B, respectively. This is in agreement with previous studies which reported that IIH affects mainly individuals aging between 15 and 44 years [24,25].

One could notice that women represented the majority of our participants in both study groups. This is in agreement with a previous report that confirmed the relationship between female sex and IIH, and the authors attributed that association to the increased prevalence of obesity in women, in addition to endocrine and hormonal changes [26].

The reader should notice that there is almost no significant difference between the two groups regarding all preoperative parameters, which should decrease any bias skewing our findings in favor of one group rather than the other, despite the nonrandomized nature of our study.

Our study showed a significant increase in operative time in group A ($P<0.001$), and that is reasonable for performing two concomitant procedures in that group instead of only one procedure in group B. The increased operative time (about 1 h) was needed to perform the LSG. This is in accordance of Barakat *et al.* [27], who reported a mean operative time for LSG near ours (76.66±14.94 min).

In the current study, LSG was associated with excellent weight loss outcomes, as the %EWL had mean values of 12.06, 28.83, and 49.09% at the scheduled three follow-up visits, respectively. In a previous systematic review, the same parameter had median values of 34.7 and 45.2% after 3 and 6 months, respectively [28]. Additionally, Osman *et al.* [29] reported that 1-, 3-, and 6-month %EWL had mean values of 13.89, 34.48, and 53.37%, respectively. The previous studies coincide with ours regarding the efficacy of LSG in achieving adequate weight loss.

Our findings showed that both interventions were associated with either resolution or improvement of the reported preoperative symptoms, including headache, visual disturbances, and tinnitus. Likewise, a previous study also reported a gradual improvement of IIH-related manifestations (headaches and impaired vision) with complete resolution in most cases (87.5%) after LSG [30]. Moreover, Lainas *et al.* [31] reported that LSG led to a 93.3% resolution of headaches, with a significant improvement of the remaining presentations (visual symptoms and tinnitus). The previous two studies followed-up their patients for 2 years after the operation, which confirmed our concept that LSG is more effective with time, when adequate weight loss is achieved.One should notice the significant improvement of papilledema grades in group A compared to the other group at 3- and 6-month visits. As weight loss began to be more apparent at these visits, the benefit of LSG begin to be more prominent, as it augmented the existing beneficial impact of LPS.

Our reported incidence of LPS-related complications lies within the reported range in the literature. The incidence of shunt obstruction ranges between 4 and 14%, while shunt infection ranges between 1 and 9% of cases [32–35]. Additionally, the incidence of shunt migration ranges between 14 and 30% in other studies [36–38].

Interestingly, all complications in group B required revision and insertion of a new shunt. However, the two migration cases encountered in group A did not present with recurrent IIH manifestations. Instead, they presented with a subcutaneous swelling about 5 months after surgery, and both of them were managed by shunt removal, with no need for the insertion of a new one, as both of them already achieved adequate weight loss, that was sufficient to control IIH manifestations. This should highlight the importance of LSG in achieving control of IIH manifestations when weight loss is adequate. However, that beneficial effect needs to be illustrated in more studies, including more cases with longer follow-up.

All in all, one could see that despite the effectiveness of both procedures in controlling most IIH-related symptoms, the combination of LPS and LSG did not add more significant morbidity. Instead, the combination eliminated the need for revision in two patients and yielded significant improvement in the papilledema compared to the isolated procedure.

Despite the unique nature of our study in handling a rare topic not previously addressed in the literature, it

has some drawbacks. Being retrospective in nature, small sample size, and lack of intermediate-term and long-term follow-up are the main ones. Therefore, it is recommended to conduct more studies in the future to cover the previously mentioned drawbacks.

Conclusion

Based on the preceding findings, concomitant LPS and LSG is a safe and effective combination for the management of IIH. The former provides early relief of symptoms, while the latter achieves effective and durable weight loss, which has a positive impact on the same manifestations.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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