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Cost-effectiveness of laparoscopic sleeve gastrectomy and laparoscopic Roux-en-Y gastric bypass in two hospitals of Tehran city in 2014

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Abstract

Background: Bariatric surgery with the improvement of obesity-related diseases, increases longevity and quality of life and is more cost-effective when compared to non-surgical Procedures.

Objective: The aim of this study is to compare the cost-effectiveness of Laparoscopic Sleeve Gastrectomy (LSG) and Laparoscopic Roux-en-Y Gastric Bypass (LRYGB).

Method: This study was performed in two stages. Initially, a cross-sectional study was carried out for costing LSG and LRYGB in Rasoul Akram and Bahman hospitals in Tehran in the year 2014. Direct costs for each surgical procedure were calculated according to the average time of surgery in both the private and public sectors. In the second stage, using Outcome (ΔBMI) collected by means of a systematic review study and cost data; cost effectiveness of two surgical procedures was examined by ICER analysis and compared with threshold limit. The Perspective of this analysis was health system.

Results: The direct cost of services for LRYGB was $ 2991.5 (98121659 Rials) in the public sector and $4221.9 in the private sector. In LSG, it was $ 1952.9 (64055468 R) in the public sector and $ 3177.2 in the private sector. ICER for LSG was 720.48(23631855 R) and $716.27 (23493924 R) in private and public sector respectively.

Conclusion: In this study, LSG procedure when compared to LRYGB was cost effective. The ICER obtained indicated that LSG surgery in comparison to LRYGB was $716.27 (23493924 R) and $720.48(23631855 R) in the public and private sector respectively. Moreover, per unit change in BMI was less than the threshold.

Keywords: Cost-effectiveness, Laparoscopic sleeve gastrectomy, Laparoscopic Roux-en-Y gastric bypass, Tehran

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Introduction

The prevalence of obesity is on the increase worldwide. According to the World Health Organization statement, by the year 2045, the number of overweight people will be up to 2.3 billion and an excess of 700 million adults will be obese (1). In Iran, the prevalence of overweight and obesity in 2005 was reported at 42.8% in men and 57% in women (2). These figures in 2015 were 54 and 74%, respectively (3).

Obesity is associated with many diseases, such as hypertension, diabetes mellitus (type 2), hyperlipidemia, coronary artery disease, sleep apnea, depression and cancers of the breast, uterus, prostate and colon (4). Several risks, such as heart disease, stroke and various cancers may be the main cause of death. While other risks such as diabetes may reduce life expectancy (5). Moreover, it was estimated that the life expectancy for obese people will be

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↑What is "already known" in this topic:
In Iran, the prevalence of overweight and obesity in men and women in 2015 was 54% and 74%, respectively. Laparoscopic sleeve gastrectomy (LSG) and laparoscopic Roux-en-Y gastric bypass (LRYGB) are current surgical procedures in Iran.

→What this article adds:
In Iran, the cost of LSG procedure is lower than LRYGB in both private and public sectors. Hence, LSG procedure is cost-effective when compared to LRYGB.

reduced between 5 and 20 years (6). The economic costs of obesity include direct costs (drug therapy, behavior therapy and control of obesity-related diseases) and indirect costs (loss of work productivity, disability and loss of life-years) (7). Studies revealed that the total direct costs of obese people (36 to 42%) are higher than non-obese people (7, 8). In view of the fact that conventional methods for controlling obesity, i.e., diet, exercise, behavior modification and drug therapy have poor and limited effect on weight loss (6), the expanding demands for Bariatric surgery with improvement of obesity-related diseases, increased longevity and quality of life is more cost-effective when compared to non-surgical process(7, 9). Given that both LSG and LRYGB procedures are carried out in Iran, LSG is newer than LRYGB (10, 11). Calculating the cost of services, due to resource constraints in the health system, provides a clear picture for experts and assists general surgeons to carefully select the best surgical procedure for patients by considering safety and effectiveness. This study was carried out for the first time in Iran, and the cost-effectiveness of both surgical procedures was evaluated from the perspective of the health system.

Methods

This study was conducted in two stages. At the initial stage, the cost of services for both surgical procedures were extracted and calculated. In the second phase, the cost-effectiveness was studied. In the first stage, a cross-sectional study was carried out for the cost of LSG and LRYGB in Rasoul Akram and Bahman hospitals in Tehran in 2014. The research area was the general surgery section of Rasoul Akram and Bahman hospitals. Data was collected from documents and patient records. In order to estimate the cost of services for these surgical procedures, the health system perspective was considered. Necessary data for calculating the cost collected during the study includes drugs and supplies for each surgical procedure, data on capital equipment in the operating room, current value and useful life of each device, data related to the salary of each surgical team member, number of daily working hours of staff, the building area in square meters and the building's current price. The mean duration of the surgery was considered as a basis for determining the cost of resources utilized (12). In the second stage, the effectiveness study results were obtained by carrying out a systematic review in some important and relevant search databases such as Cochrane library, PubMed, trip, ovidmedline, CRD, Magiran, Iranmedex and Sid. Data bases were searched until July 2014 for randomized control trials. The population included people aged between 18–60 years, with BMI≥35 and at least one obesity-related disease, or people with BMI≥40. BMI change, as research outcome, was investigated at least in one-year follow-up period. The results were extracted from articles. Thereafter, the cost-effectiveness of the two procedures was compared with each other according to ICER analysis.

The costs of the surgical team (a six-member team) were taken from the hospital accounting unit on the basis of average salary and benefits for each personnel in a month, and was allocated based on the average time of surgery. The average time of surgery, 110 min for LSG, and 135 min for LRYGB were considered as the basis for calculation(12). To estimate the wage of operating room technicians, anesthesia technicians and nurses, $ 609.75 (20000000 R) per month was considered on average. The wage of surgeons was calculated based on the surgery K-value in 2014 and the tariffs announced by the Ministry of Health. In this regard, wage was considered on the basis of both public and private tariffs. Furthermore, 20% of the surgeon's commission was added to the surgery cost as the cost of Laparoscopy. The surgery K-value was announced as $ 2.68(88,000 R) for the public sector and $ 11.58 (380,000 R) for the private sector. The cost of materials utilized was calculated from the list of supplies in each surgery based on the market prices. The cost of drugs utilized for each surgery was extracted from the drug list in the prescription of the operating room, and their costs were calculated by visiting the hospital pharmacy and inquiring about the prices of medicines and consumables. The capital equipment costs were calculated from the updated property list of the hospital. In order to estimate the depreciation expense for the operating room equipment, the Straight-Line method was utilized. The useful life for equipment was as considered 10 years and the residual value was considered as zero. After calculating depreciation expense (depreciation= initial value - residual value/useful life) for a year, depreciation expense was calculated for a day based on the operating time for each surgery procedure.

The building cost was estimated by referring to one of the estate agents in the area. In order to calculate the depreciation cost of the building, the value per square meter of Rasoul Akram Hospital was determined as $ 10670.73 (350000000 R). The useful life was considered as 30 years and the residual value was considered as $ 609.76 (20000000 R) per square meter. According to the operating room area (300 square meters), the depreciation of the operating room was calculated for a day and finally, based on the time of surgery in each procedure, the building depreciation was calculated. The expert opinions were used on the number of consultations and visits in the patient's hospitalization days and one year after surgery. For each patient, two consultations for heart and lungs whose tariffs for public and private sectors were announced separately were considered. It was $ 6.1(200000 R) in the public sector and $ 15.85(520000 R) in the private sector. Doctor call for each patient was carried out before and after surgery and then twice in the first month and then once every 3 months. Given that for LRYGB and LSG, the patient is hospitalized three nights, a total of 11 visits were carried out up to a year after surgery.

Results

Based on the calculations, the cost results are provided in separate Tables 1 and 2 for each surgical procedure. Finally, the calculated cost of services for each surgical procedure in the public and private sectors are summarized in Table 3.

Table 1. The calculated cost of services ($)

Surgical procedure	Average time of surgery	Supplies and drugs costs	Visit costs (tariff for private sector)	Visit costs(tariff for public sector)	Surgical wage (operating room technician, anesthesia technician and nurse)	Depreciation cost the building	Depreciation cost the capital equipment
LRYGB	135	2572.96 (84393367 R)	87.19 (2860000 R)	33.53 (1100000 R)	28.58 (937500 R)	1.17 (38527 R)	5.39 (177065 R)
LSG	110	1534.77 (50340711 R)	87.19 (2860000 R)	33.53 (1100000 R)	23.28 (763890 R)	0.96 (31392 R)	4.39 (144275 R)

Table 2. The wage of surgical (surgeon, assistant, anesthesia) ($)

Surgical procedure	Average time of surgery	Surgical wage (surgeon, assistant, anesthesia) tariff for private sector	Surgical wage (surgeon, assistant, anesthesia) tariff for public sector	Anesthesia K-value	Surgical K-value
LRYGB	135	1510.73 (49552000 R)	349.85 (11475200 R)	10	86
LSG	110	1510.73 (49552000 R)	349.85 (11475200 R)	10	86

In order to evaluate the cost-effectiveness, the effectiveness study results were utilized. The mean of BMI changes found in 4 clinical trials for LSG and LRYGB were 14.2 and 15.6, respectively (13). The results of the systematic review of 4 clinical trial studies (14-17) on the outcome of BMI showed that LSG when compare to LRYGB has less effect. Therefore, due to the relatively low cost and low effectiveness in LSG surgery, it was necessary to conduct ICER analysis. ICER for LSG was $720.48(23631855 R) and $ 716.28 (23493924 R) in private and public sector, respectively (Tables 4, 5, and 6). Per unit change in BMI was less than the threshold. GDP per capita for Iran was $ 766.6 (25144425 R) according to the central bank report in the year 2014. Three times GDP per capita is determined as a threshold limit value by WHO in decision making.

Discussion

In calculating the cost of both surgical procedures based on private and public tariffs, the cost of LRYGB was higher than LSG (2991.5(98121659 R), $ 1952.9 (64055468 R) in the public sector and 4221.9(138478459 R), $3177.2 (104212268 R) in the private sector respectively) and based on ICER, the obtained LSG procedure in comparison to LRYGB was cost effective. Certainly, this result was obtained from a number of small sized studies. According to the studies included in the systematic review, to assess the effectiveness and the importance of long-term follow-up of patients based on the outcome of weight loss, no studies with more than 5 years follow up of patients have been carried out.

Heo et al. (2011) calculated the direct costs of both procedures (18). In the study, the direct medical costs included costs of initial surgery and regular visits in a year. In line with the results of our study, LRYGB had more cost. To the best of our knowledge, there is no study on the cost-effectiveness of both procedures. Hence, the comparison group was considered as non-surgical procedures.

Table 3. The direct costs of medicine ($)

surgical procedure	direct costs of medicine in the private sector	direct costs of medicine in the public sector
LRYGB	4221.9 (138478459 R)	2991.51 (98121659 R)
LSG	3177.2 (104212268 R)	1952.9 (64055468 R)

Song (2013) used the costs obtained by Heo et al. to evaluate the cost-effectiveness of both surgical procedures compared with non-surgical procedures (19). In this study, the cost utility analysis showed that bariatric surgery has $ 1,522 incremental cost and 0.86 incremental QALY when compared with non-surgical procedures. Overall, the study suggested that the surgical intervention for bariatric surgery is more cost- effective when compared to non-surgical procedures. In a study carried out by Salem et al, the ICER ratio of surgery compared with non-surgical procedures was reported. They found that ICER in RYGB when compared to non-surgical procedures is $14680 to $18543 per QALY (20).

Picot et al. (2009) in the Health Technology Assessment report estimated the incremental cost-effectiveness ratio of bariatric surgery in QALY which was £6289 for gastric bypass. In this study, surgical intervention was more cost-effective when compared to non-surgical intervention. Nevertheless, laparoscopic and open surgical procedures were included in this study which does not comply with the present study. The cost of surgery for only laparoscopic gastric bypass was £ 6985, from which approximately £ 1200 to £ 2000 relates to the cost of consumables (including clamps used in gastric bypass and equipment). Moreover, pre-surgery cost was estimated at £1114 and the cost of care after discharge for patients in the subsequent two years was estimated at £1800 for LRYGB. The total cost of LRYGB was predicted as £ 11462. These costs included the use of additional resources due to side effects during hospitalization, second surgery in two years for patients who did not have a successful surgery (21).

Table 4. ICER in public sector ($)

Comparator	Cost	Δ cost	Effectiveness (change Mean BMI)	Δ Effectiveness	ICER
LSG	1952.9 (64055468 R)		14.2	1.45	716.28 (23493924 R)
LRYGB	2991.5 (98121659 R)	1038.6 (34066191 R)	15.65		

Table 5. ICER in private sector ($)

Comparator	Cost	Δ cost	Effectiveness (change Mean BMI)	Δ Effectiveness	ICER
LSG	3177.2 (104212268 R)		14.2	1.45	720.48 (23631855 R)
LRYGB	4221.9 (138478459 R)	1044.7 (34266191 R)	15.65		

Table 6. Matrix decision in cost effectiveness analysis

E new> E old	E new= E old	Effectiveness E new< E old	The comparison of new and old alternatives
New alternative dominates	New alternative dominates	ICER estimation	Cost C new< C old
New alternative dominates	New = old	Old alternative dominates	C new= C old
ICER estimation	Old alternative dominates	Old alternative dominates	C new> C old

Maklin et al. (2011) carried out a study in Finland to assess the cost-utility of LRYGB and LSG compared with conventional therapies. In the analysis, bariatric surgery was more effective and less expensive than conventional therapies. Researchers examined the costs of both open surgery and laparoscopy procedures compared with conventional procedures. The intervention cost, the average annual cost of care for patients in both treatment groups (surgery and conventional treatment) excluding drug cost were estimated. It was € 14672 for LRYGB, € 14752 for LSG, € 6488 for second surgery and € 2413 for follow-up for a year (22).

The results of the study by Wang et al. (2013) showed ICER for LRYGB compared with non-surgery at 6600 US dollars. The threshold was $ 50,000 per QALY (23). Furthermore, in a study by Flum et al. (2010), the ICER ratio of LRYGB compared to non-surgery was estimated at $ 13000 which was less than the threshold (24).

The results of cost-effectiveness study by Henteleff et al. (2013) revealed that bariatric surgery increased quality-adjusted life- years (QALY) and costs. In gastric bypass surgery, the cost effectiveness ratio was $ 7,000 per QALY in patients with severe obesity, which was reported as the cost-effective procedure in the analysis (25).

Given that in the effectiveness section, the clinical trials found were included in the systematic review with number and small size; therefore, different results in different studies and trials with small size cannot provide an appropriate response in terms of effectiveness. However, most studies are non-randomized and observational, and clinical trials did not report a follow-up of more than five years for patients undergoing LSG. Thus, obtaining a definitive answer in future studies in terms of effectiveness will help us explore the cost-effectiveness aspect with full confidence.

Conclusion

The wider acceptance of bariatric surgery by patients and healthcare suppliers has challenged the resources used in healthcare systems. Cost is an important factor for conducting a bariatric surgery. In summary, according to the findings of this study, the cost of services for LSG was lower than LRYGB in both the public and private sectors. ICER analysis and its comparison with threshold limit value showed that LSG procedure is cost-effective when compared to LRYGB.

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