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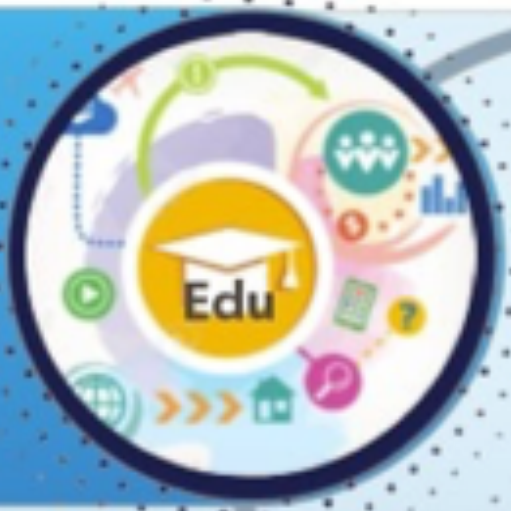

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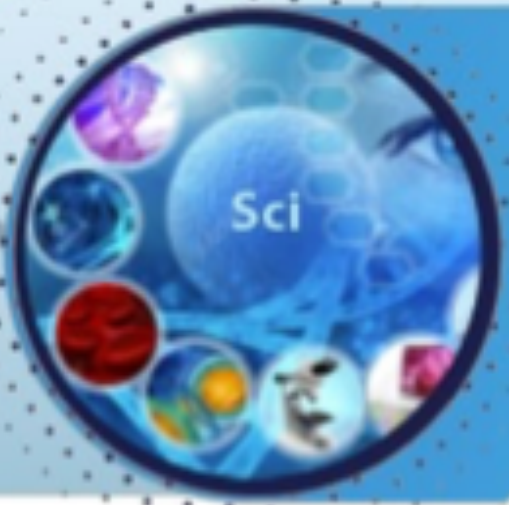

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Comparative Evaluation of Standard and Modified Bariatric Procedures in Patients with Metabolic Syndrome: a clinical outcome study

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ABSTRACT

Background. *Metabolic syndrome remains a major global health challenge. Bariatric surgery has shown high efficacy, yet the variability in patient profiles demands optimization of surgical approaches.*

Objective. *To compare clinical outcomes of standard and modified bariatric procedures in patients with metabolic syndrome, focusing on weight loss efficacy, remission of metabolic markers, and complications.*

Methods. *A prospective cohort of 225 patients undergoing bariatric surgery was analyzed. Group 1 (n=107) received standard LSG or OAGB. Group 2 (n=118) received modified procedures: anti-reflux LSG or tailored OAGB with individualized limb length. Outcomes included %EWL, HbA1c, HOMA-IR, GERD symptoms, and micronutrient status, assessed at 6 and 12 months.*

Results. *Group 2 demonstrated superior %EWL at 12 months (84.3±6.8% vs. 76.1±7.3%, p<0.001) and greater reduction in HbA1c (-2.3±0.6% vs. –1.7±0.5%, p<0.01). GERD symptoms persisted in 18.7% of Group 1 but only in 6.8% of Group 2 (p<0.05). Nutrient deficiencies were comparable between groups, though vitamin D deficit was slightly higher in the OAGB subgroup.*

Conclusion. *Modified bariatric procedures tailored to metabolic phenotype and anatomical profile provide improved outcomes in patients with metabolic syndrome, especially in terms of glycemic control and reflux management. Personalized surgical planning should be integrated into standard bariatric protocols.*

Keywords: *Metabolic syndrome, bariatric surgery, LSG, OAGB, GERD, weight loss, individualized approach.*

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INTRODUCTION

Metabolic syndrome (MetS) represents a cluster of interrelated conditions—including central obesity, insulin resistance, hypertension, and dyslipidemia—that significantly increase the risk of type 2 diabetes mellitus (T2DM) and cardiovascular disease [1]. The global prevalence of MetS continues to rise, with a substantial portion of affected individuals demonstrating resistance to lifestyle modification and pharmacotherapy alone [2].

Bariatric surgery has emerged as one of the most effective interventions for achieving sustained weight loss and remission of metabolic abnormalities in obese individuals with MetS. Among the available procedures, laparoscopic sleeve gastrectomy (LSG) and one-anastomosis gastric bypass (OAGB) are widely used due to their metabolic benefits and relatively favorable safety profiles [3, 4]. However, standardization of these techniques has come under scrutiny due to increasing recognition of variable patient responses, especially in the context of preexisting gastroesophageal reflux disease (GERD), insulin resistance levels, and variations in small bowel length [5, 6].

Recent studies have indicated that modified surgical approaches (such as anti-reflux LSG and tailored OAGB with customized biliopancreatic limb lengths) may optimize postoperative outcomes by reducing reflux incidence and improving glycemic control [7]. Moreover, the integration of individual metabolic and anatomical characteristics into preoperative planning has gained support as a means of enhancing both efficacy and safety [8].

Despite these developments, comparative data on standard versus modified bariatric techniques in the specific context of MetS remain limited. This study aims to fill that gap by analyzing 12-month outcomes in patients undergoing either standard or phenotypically adapted bariatric procedures, focusing on weight loss, metabolic remission, GERD evolution, and nutritional status.

MATERIALS AND METHODS

Study Design and Population

This was a prospective comparative cohort study conducted at the Department of Surgery, Tashkent Medical Academy, between 2019 and 2023. A total of 225 patients with confirmed metabolic syndrome (MetS), based on the International Diabetes Federation criteria [1], were enrolled. All patients were eligible for bariatric surgery and underwent comprehensive preoperative evaluation.

Patients were divided into two groups based on the surgical technique used:

- Group 1 (Standard procedures): 107 patients underwent classical laparoscopic sleeve gastrectomy (LSG, n=66) or standard one-anastomosis gastric bypass (OAGB, n=41) using fixed limb lengths.
- Group 2 (Modified procedures): 118 patients underwent either anti-reflux LSG (AR-LSG, n=63) or individualized OAGB (i-OAGB, n=55), with tailoring of biliopancreatic limb length based on preoperative HOMA-IR, BMI, and C-peptide levels.

Surgical Techniques

All procedures were performed laparoscopically by the same experienced surgical team. In AR-LSG, anti-reflux modifications included reinforcement of the angle of His and narrowing of the incisura angularis. In i-OAGB, limb length ranged from 150 to 250 cm, adjusted according to metabolic and anatomical profiles.

Outcome Measures

Primary endpoints: %EWL (percent excess weight loss) at 6 and 12 months; HbA1c (%) and HOMA-IR index (insulin resistance); GERD symptom evolution, assessed via GERD-Q score; Micronutrient status, including vitamin B12, iron, and vitamin D; Secondary endpoints included operative time, length of hospital stay, early (<30 days) and late (>30 days) complications, and readmission rates.

Data Collection and Statistical Analysis

All patients were followed postoperatively at 1, 3, 6, and 12 months. Laboratory evaluations were performed using standardized assays. GERD symptoms were evaluated clinically and via endoscopy when indicated.

Statistical analysis was conducted using SPSS version 26.0. Quantitative variables were expressed as mean ± standard deviation and compared using Student's t-test or Mann–Whitney U-test. Categorical variables were compared using χ^2 test. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 225 patients with metabolic syndrome were included in the study, with no statistically significant differences between groups in terms of age, gender distribution, baseline BMI, HbA1c, or HOMA-IR values ($p>0.05$). The mean age was 41.6±7.8 years and the mean BMI was 41.2±4.1 kg/m^2. Both groups were metabolically comparable at baseline.

At 12 months postoperatively, patients who underwent modified bariatric procedures (Group 2) achieved greater excess weight loss, with mean %EWL reaching 84.3±6.8%, compared to 76.1±7.3% in the standard procedure group ($p<0.001$). Improvements in glycemic control were also more pronounced in Group 2, with a mean HbA1c reduction of –2.3±0.6% versus –1.7±0.5% in Group 1 ($p<0.01$). The reduction in HOMA-IR was 61.2% in Group 2 and 45.7% in Group 1, with the difference being statistically significant ($p<0.05$).

Gastroesophageal reflux symptoms were more prevalent in patients after standard LSG, where 18.7% reported persistent or de novo reflux at 12 months, compared to only 6.8% in the anti-reflux LSG subgroup ($p<0.05$). Among OAGB patients, those who received tailored limb lengths showed better tolerance and fewer instances of diarrhea and anemia, although vitamin D deficiency was slightly more common in Group 2 (23.6% vs. 18.4%).

Postoperative complications were less frequent in the modified procedure group (5.1%) compared to the standard group (9.3%), although the difference was not statistically significant ($p=0.11$). Operative time was slightly longer in Group 2 (92.5 vs. 87.4 minutes), but hospital stay was similar across both groups, averaging 3.3 days.

In summary, modified bariatric procedures resulted in superior outcomes in weight loss, glycemic control, and reflux prevention, while maintaining an acceptable safety and nutritional profile.

DISCUSSION

The findings of this study demonstrate that individualized modifications of bariatric procedures result in significantly better clinical outcomes for patients with metabolic syndrome. Patients in the modified procedure group achieved higher %EWL and greater reductions in HbA1c and HOMA-IR, consistent with prior research suggesting that tailoring surgical technique to metabolic phenotype can improve efficacy [1,2].

The enhanced glycemic control observed in the personalized OAGB subgroup is likely attributable to optimized limb length, which influences nutrient absorption and hormonal response. Previous studies have shown that longer biliopancreatic limbs improve remission of type 2 diabetes but increase the risk of malabsorption [3]. Our individualized approach appears to strike a favorable balance, as micronutrient deficiencies remained within acceptable limits.

Reflux control is a key concern in bariatric patients, particularly after LSG. The significantly lower GERD incidence in patients who underwent anti-reflux LSG confirms that surgical modification of the gastroesophageal angle and preservation of the incisura angularis can reduce postoperative reflux [4, 5]. These findings support the emerging consensus that LSG should not be applied uniformly and that reflux-prone patients require anatomical adjustment [6].

While standard OAGB remains an effective and technically straightforward option, our results suggest that a one-size-fits-all limb length may not be optimal, especially in metabolically complex cases. Recent data from international bariatric registries also indicate that individualized limb length planning leads to better long-term weight loss and metabolic stability [7].

Although the complication rate was numerically lower in the modified group, the difference was not statistically significant, possibly due to sample size limitations. Nevertheless, the absence of severe complications and comparable nutritional outcomes suggests that individualized surgery does not increase risk. Operative time was slightly prolonged, but within acceptable limits for elective procedures.

These findings emphasize the importance of preoperative stratification and intraoperative adaptation based on patient-specific criteria. Algorithms incorporating HOMA-IR, C-peptide levels, GERD history, and anatomical variations could guide the selection and customization of bariatric techniques, improving outcomes across heterogeneous metabolic profiles [8].

Limitations of this study include its single-center design and lack of long-term follow-up beyond 12 months. Further multicenter trials with extended observation periods are needed to confirm the durability of these results and validate the proposed modifications across diverse populations.

CONCLUSION

This prospective study demonstrates that modified bariatric procedures—namely anti-reflux sleeve gastrectomy and individualized one-anastomosis gastric bypass-lead to superior weight loss, better glycemic control, and a lower incidence of gastroesophageal reflux in patients with metabolic syndrome. Despite slightly longer operative times, these tailored approaches were associated with comparable complication rates and nutritional safety.

The results support the incorporation of patient-specific metabolic and anatomical parameters into preopera-

tive planning to guide the choice and design of surgical procedures. Personalized bariatric surgery may represent a new standard in optimizing outcomes for complex metabolic patients, and future guidelines should consider stratified algorithms in routine clinical practice.

Ethical Approval:

This study was approved by the Local Ethics Committee of Tashkent Medical Academy. All participants gave written informed consent before surgery.

Conflict of Interest:

The author declares no conflict of interest.

Funding:

This research was conducted without external funding and supported by institutional resources.

Author Contributions:

Khamdamov I.B. – Conceptualization, surgical management, patient follow-up, data analysis, manuscript writing.

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METABOLIK SINDROMLI BEMORLARDA STANDART VA MODIFIKATSIYALANGAN BARIATRIK OPERATSIYALARNING KLINIK NATIJALARINI TAQQOSLASH

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Buxoro davlat tibbiyot universiteti, Buxoro, O‘zbekiston

ANNOTATSIYA

Ushbu tadqiqot metabolik sindromga ega bo‘lgan 225 bemorda standart (LSG, OAGB) va modifikatsiyalangan (antireflyuks LSG, individualizatsiyalangan OAGB) bariatrik operatsiyalar samaradorligini solishtiradi. 12 oylik kuzatuvda modifikatsiyalangan operatsiyalar ortiqcha vazn yo‘qotish (%EWL 84,3% ga nisbatan 76,1%, p<0,001), glikemik nazorat (HbA1c –2,3% ga nisbatan –1,7%, p<0,01) va GERD simptomlarining kamayishida (6,8% ga nisbatan 18,7%, p<0,05) yuqori samaradorlikni ko‘rsatdi. Oziqlanish bilan bog‘liq asoratlar o‘rtacha bo‘lib, xavfsizlik profili har ikki guruhda qoniqarli deb baholandi. Natijalar shuni ko‘rsatadiki, bemor fenotipiga moslashtirilgan jarrohlik yondashuvlari metabolik sindromli bemorlar uchun optimal natijalar beradi.

Kalit so‘zlar: Metabolik sindrom, bariatrik jarrohlik, LSG, OAGB, GERD, shaxsiylashtirilgan yondashuv.

СРАВНИТЕЛЬНАЯ ОЦЕНКА СТАНДАРТНЫХ И МОДИФИЦИРОВАННЫХ БАРИАТРИЧЕСКИХ ВМЕШАТЕЛЬСТВ У БОЛЬНЫХ С МЕТАБОЛИЧЕСКИМ СИНДРОМОМ: КЛИНИЧЕСКОЕ ИССЛЕДОВАНИЕ

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АННОТАЦИЯ

В исследование включены 225 пациентов с метаболическим синдромом, перенёсших либо стандартные (LSG, OAGB), либо модифицированные (антирефлюксные LSG и индивидуализированные OAGB) бариатрические операции. По результатам 12-месячного наблюдения, модифицированные вмешательства обеспечили лучшие показатели потери лишнего веса (%EWL 84,3% против 76,1%, p<0,001), более выраженное снижение HbA1c (–2,3% против –1,7%, p<0,01), а также значительно меньшую частоту симптомов ГЭРБ (6,8% против 18,7%, p<0,05). Частота нутритивных дефицитов была сопоставимой, а профиль безопасности – удовлетворительным в обеих группах. Полученные данные свидетельствуют о целесообразности индивидуализированного хирургического подхода при лечении пациентов с метаболическим синдромом.

Ключевые слова: Метаболический синдром, бариатрическая хирургия, LSG, OAGB, ГЭРБ, индивидуализированный подход.