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The study effect of Bariatric Surgery on Bile Salt Metabolism and Gallstone Formation: Risk Factors, Preventive Strategies, and Clinical Implications

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ABSTRACT

Bariatric surgery is seen as a safe and functional treatment for fatness an associated comorbid conditions. Also, nevertheless, it is linked with an incre risk of gallstone formation. The risk factor is believed to be due to perturbatic bile salt equilibrium, rapid weight loss, and alteration in the composition of Bile salt metabolism differences are compared between five common bari operations (sleeve gastrectomy (SG), Roux end Y gastric bypass (RYGB), gastric bypass (MGB), single anastomosis sleeve ileal bypass (SASI), and si anastomosis sleeve jejunal bypass (SASJ)) and to what degree these differe might contribute to gallstones.

The results demonstrate that procedures that bypass the duodenum, jejunun ileum (RYGB, MGB, SASI, SASJ) have serious consequences on bile reabsorption, contributing to high cholesterol supersaturation and creatio gallstones. SG from a bile salt perspective had the least direct impact; however rapid weight loss occurring postoperatively also created a moderate ris gallstone formation. Treatment strategies such as ursodeoxycholic acid (UD therapy scheduled intervals post-surgery combined with gradual weight loss dietary changes and considerations were effectively utilized in decreasing galls formation.

This paper illuminated the need for individualized treatment approaches procedures that are associated with greater post-operative risk RYGB or M procedures. Prompt interventions and timely prescribed medications monitoring are critical in the care of these patients to realize better outcomes have less post-operative complications.

INTRODUCTION

Bariatric surgery is a successful treatment for morbid obesity and obesity-related issues such as type 2 diabetes, hypertension, and dyslipidemia [1]. These procedures such as SG, RYGB, MGB, SASI, and SASJ are frequently used for obtaining long-term weight loss. The procedures are, nevertheless, accompanied by complications, most notably gallstone formation, which have a significant impact on quality of life in patients and may necessitate further intervention [2].

Gallstone pathogenesis is a multifactorial process on the basis of alterations in the composition of bile, bile salt metabolism, and gallbladder motility. Restrictive surgery like SG causes rapid weight loss, increasing cholesterol secretion into bile and reducing gallbladder contractility, facilitating gallstone formation. Malabsorptive surgery (e.g., RYGB, MGB, SASI, SASJ) enhances this risk by disrupting the reabsorption of bile salts, causing supersaturation of cholesterol [3].

Preventive interventions, like UDCA treatment, dietary modification, and gradual weight loss, can be effective in decreasing the formation of gallstones. Here, the influence of different types of bariatric surgery on bile salt metabolism and gallstone risk is examined to better manage patients postoperatively and improve outcomes [4].

METHODOLOGY

The research involved participants who received bariatric surgery as their treatment at [two different hospitals] for duration [2022-2024]. 96 patients in total included during the study, they have (SG, RYGB, MGB, SASI, or SASJ).

SAMPLE COLLECTION AND ANALYSIS

The research team obtained blood samples measuring 5 milliliters before surgery and at 6 and 12 months after the operation. The scientists separated serum through centrifugation and then placed it in storage at -20°C for further examination. The doctors used abdominal ultrasound to evaluate the development of gallstones in patients.

The FX CorDiax 80 by Fresenius Medical Care from Germany was employed to perform hemodialysis through Helixone®high-flux membrane that has 1.8 square meters of surface area. The scientists measured liver function markers which include ALT and AST together with bilirubin levels and lipid profiles before analyzing bile acid concentrations with high performance liquid chromatography.

STATISTICS CALCULATION

SPSS software was used for data analysis. Change in bile acid levels was assessed using paired t-tests and ANOVA. Risk factors for gallstone formation were identified using logistic regression. The significant indicator of all statistics is P (value <0.05).

RESULTS

Group A: Bile Acid Dysregulation Group its evidence UOBM demonstrated an alteration in bile acid metabolism characterized by poor cholic to Chenocholic ratio indicative of diminished solubility and higher cholesterol saturation as key players for the pathogenesis biliary stones.

Ursodeoxycholic Acid (UDCA) Therapy: Daily dose of UDCA (500mg) for 6 months following the operation markedly

decreased postembolization gallstone formation.

Nutritional Changes: A diet low in saturated fat and rich in fiber is good for the gallbladder and also lowers the risk of stone development.

Surgical Weight loss management: Slow weight loss strategies following surgery are less likely to lead to the development of gallstones than rapid weight gain.

This table provides a more detailed summary of the key factors related to gallstone formation after bariatric surgery and stresses on preventive methods which have been identified from this study.

Table 1 Extended This table provided a comprehensive summary of the findings along with important factors and recommendations for post-bariatric surgery gallstone formation prevention Table (1)

BARIATRIC SURGERY TYPES, BILE SALTS, AND GALLSTONE FORMATION

1. **Highest Risk Procedures:**

RYGB and MGB present the greatest danger of gallstone development as a result of very strong disturbances in the bile salt system and very fast weight loss.

2. **Moderate Risk Procedures:**

Sleeve Gastrectomy, SASI, and SASJ have moderate risk and yet lead to bile stasis and cholesterol in the bile, which are causes of gallstones.

3. **Mechanism of Gallstone Formation Across Procedures:**

Modified reabsorption of bile salts (particularly with bypass surgeries) results in cholesterol becoming highly saturated in the bile. The danger is further aggravated by the rapid weight loss as it elevates the secretion of cholesterol in bile and decreases the movement of the gallbladder.

4. **Preventive Measures:**

In those cases when bile salt reabsorption is abnormal (especially in the bypass operations), cholesterol supersaturated bile is produced. Fast weight loss amplifies the risk by boosting bile cholesterol secretion and inhibiting gallbladder motility.

Ursodeoxycholic Acid (UDCA): UDCA treatment can be used as a prevention method to lower the risk of gallstones.

Weight Reduction at a Slow Pace: A slower weight loss decreases the ratio of gallstone formations.

Postoperative Surveillance: The use of rapid, non-ionizing, and non-invasive imaging methods (e.g., ultrasound) for timely diagnosis of gallstones is of utmost importance, especially when it is necessary to monitor high-risk operations like RYGB and MGB.

DISCUSSION

Results of the research into gallstone development and bile acids after bariatric surgery present a number of interesting findings and trends: Rate of gallstone formation

Observation: Gallstones or bile sludge developed in 50% of the patients (Group A), while the other 50% did not (Group B).

Implications: The high prevalence makes gallstones a common complication after bariatric surgery. We need to focus on prevention and follow-up to lessen this issue [5].

BILE ACID DYSREGULATION

Observation: Gallstones formed in patients with disrupted bile acid metabolism, including reduced solubility and increased cholesterol saturation of bile. Method: Bariatric surgery, particularly the malabsorptive ones such as (RYGB), alters the enterohepatic circulation of bile acids [6]. Consequently, it diminishes the pools of bile salts since biliary secretion depends on their return to the liver. This creates an

imbalance and results in supersaturation of bile which is one prerequisite for gallstone formation. Clinically Related: To normalize the balance, e.g., therapy with ursodeoxycholic acid this risk can be reduced successfully.

WEIGHT LOSS PATTERNS

Observation: Group A patients experienced immediate weight loss following surgery compared to Group B. Method: Hyper lipolysis with over consequent wasting precipitates output of excess cholesterol into the bile. At the same time, motility of the gallbladder is reduced and therefore bile stasis occurs. These two conditions favor gallstone formation. Controlled gradual weight loss prevents risk of bile stasis and supersaturation of cholesterol; hence, postoperative weight management should emphasize caution in handling weights. Lipid Profile Total Cholesterol and Triglycerides: Grouping A had slightly higher levels than grouping B, though the differences were not statistically significant. LDL and HDL: There were no significant differences between the two groups. Implications: Dyslipidemia is a known risk factor for gallstone formation, but the results indicate that bile acid dysregulation and gallbladder motility are more important in this patient group [7]. Observation: Diabetes was more common in non-gallstone patients, grouping B have 43.8% while grouping A have 20.8% and ($p = 0.02$). Interpretation: This finding is indicative of a complex interaction between diabetes, the way the body handles metabolism, and metabolism of bile acids. The reasons could be:

Diabetes can affect bile composition by modifying bile acid signaling.

Diabetic patients have weaker gallbladder contractions, which may prevent gallstones from forming tem

Observation: Hypertension was more common in grouping A (52.1%) while grouping B (39.6%), but the difference was not statistically significant. Implications: Hypertension may be involved indirectly in gallstone formation by its relationship with obesity and metabolic syndrome.porarily. Further Studies: More studies are needed to know more about the protective mechanisms . Patients who received UDCA prophylaxis had significantly lower gallstone formation rates [9]. UDCA works by increasing the solubility of bile acids and reducing the saturation of cholesterol in bile. Clinical Practice Implication: Routine administration of UDCA in high-risk post-surgical patients can be an effective preventive measure. Dietary Modifications: A high-fiber, low-saturated-fat diet preserved gallbladder function by preventing cholesterol secretion into bile and augmenting motility. Recommendation: Institute dietary counseling for all bariatric surgery patients. Gradual Weight Loss: Patients with a decreased rate of weight loss had decreased risk for gallstones.

Guidance: Weight loss goals should balance surgical outcomes against reducing complications such as gallstones. Timing of Gallstone DetectionObservation: Gallstones most frequently occurred in the first postoperative year (average time: ~337 days in Group A).

Implications: This suggests a period of close monitoring and intervention. Prophylactic intervention and ultrasound screening must be targeted during this period.

Dissection of the Bariatric Surgery Table

The table provides a comparative review of the various forms of bariatric surgeries, their effect on bile salt metabolism, and their relative risk of gallstone formation.

What follows is a detailed discussion of the key findings

1. (SG)

Procedure Description: Involves removal of the majority (~75-80%) of the stomach, creating a tubular stomach "sleeve." Effect on Bile Salts: None or minimal direct impact on the circulation of bile salts. However, the reduced stomach volume can promote bile stasis. Gallstone Risk: Moderate, mainly due to the acute weight loss postoperatively. Comments: Preemptive strategies like ursodeoxycholic acid (UDCA) therapy and gradual weight loss successfully reduce risk [10].

2. (RYGB)

Procedure Description: Creates a reduced gastric reservoir and bypasses most of stomach and duodenum, anastomosing directly to the jejunum. Impact on Bile Salts: Significantly reduces bile salt absorption due to duodenal and jejunal bypass. Gallstone Risk: High, secondary to dysregulation of bile salts and excessive postoperative weight loss. Comments: One of the highest risks of gallstones with this procedure, making early prevention strategies like UDCA therapy and monitoring postoperatively very important [11].

3. (MGB)

Procedure Description: A simplified RYGB with a single stomach-jejunum anastomosis [12].

Effect on Bile Salts: Reduces bile salt reabsorption, similar to RYGB, and exposes the patient to bile reflux. Gallstone Risk: High, with additional risks of bile reflux. Remarks: The increased bile reflux necessitates careful patient monitoring and dietary interventions [13].

4. (SASI)

Operation Description: Combines a sleeve gastrectomy with bypassing a portion of the ileum.

Effect on Bile Salts: Significantly alters bile salt circulation by bypassing the ileum [14]. Gallstone Risk: Moderate to high. Comments: Metabolic advantages are provided by this combination operation, but it increases gallstone risks and must be followed closely [15].

5. (SASJ)

Procedure Description: Combines sleeve gastrectomy with bypassing a portion of the Jejunum.

Impact on Bile Salts: Alters bile salt reabsorption(,1617). Gallstone Risk: Moderate. Comments: Reduced bile salt absorption accounts for gallstone development.

CONCLUSION

The study indicates bile acid dysregulation, weight loss, and gallbladder dysfunction as strong inducers of gallstone formation after bariatric surgery. Preventive interventions like UDCA therapy, weight loss, and diet modification are efficacious in reducing the risk of gallstones. Interestingly, the role of diabetes remains unclear and requires further research. In conclusion, these results stress the need for a patient-specific, multidisciplinary strategy for managing bariatric surgery patients' gallstone risk.

REFERENCES

1-calovschi, M. (2001). Cholesterol gallstones: From epidemiology to prevention. *Postgraduate Medical Journal, 77*, 221–229.

2-Chang, J., Corcelles, R., Boules, M., Jamal, M. H., Schauer, P. R., & Kroh, M. D. (2016). Predictive factors of biliary complications after bariatric surgery. *Surgery for*

Obesity and Related Diseases, 12, 1706–1710.

3-Dan, W.-Y., Yang, Y.-S., Peng, L.-H., Sun, G., & Wang, Z.-K. (2023). Gastrointestinal microbiome and cholelithiasis: Current status and perspectives. *World Journal of Gastroenterology, 29*, 1589–1601.

4-Davies, N. K., O'Sullivan, J. M., Plank, L. D., & Murphy, R. (2019). Altered gut microbiome after bariatric surgery and its association with metabolic benefits: A systematic review. *Surgery for Obesity and Related Diseases, 15*, 656–665.

5-Guman, M. S. S., Hoozemans, J. B., Haal, S., de Jonge, P. A., Aydin, Ö., Lappa, D., … Bäckhed, F. (2022). Adipose tissue, bile acids, and gut microbiome species associated with gallstones after bariatric surgery. *Journal of Lipid Research, 63*, 100280.

6-Gutiérrez-Díaz, I., Molinero, N., Cabrera, A., Rodríguez, J. I., Margolles, A., Delgado, S., & González, S. (2018). Diet: Cause or consequence of the microbial profile of cholelithiasis disease? *Nutrients, 10*, 1307.

7-Guzmán, H. M., Sepúlveda, M., Rosso, N., San Martin, A., Guzmán, F., & Guzmán, H. C. (2019). Incidence and risk factors for cholelithiasis after bariatric surgery. *Obesity Surgery, 29*, 2110–2114.

8-Iglézias Brandão de Oliveira, C., Adami Chaim, E., & da Silva, B. B. (2003). Impact of rapid weight reduction on risk of cholelithiasis after bariatric surgery. *Obesity Surgery, 13*, 625–628.

9-Komorniak, N., Martynova-Van Kley, A., Nalian, A., Wroński, M., Kaseja, K., Kowalewski, B., … et al. (2022). Association between fecal microbiota, SCFA, gut integrity markers and depressive symptoms in patients treated in the past with bariatric surgery: A cross-sectional study. *Nutrients, 14*, 5372.

10-Lazarchuk, I., Barzak, B., Wozniak, S., Mielczarek, A., & Lazarchuk, V. (2023). Cholelithiasis—A particular threat to women: A review of risk factors. *Medical Journal of Cell Biology, 11*, 20–27.

11-Li, V. K. M., Pulido, N., Fajnwaks, P., Szomstein, S., Rosenthal, R., & Martinez-Duartez, P. (2009). Predictors of gallstone formation after bariatric surgery: Multivariate analysis comparing gastric bypass, gastric banding, and sleeve gastrectomy. *Surgical Endoscopy, 23*, 1640–1644.

12-Liu, B.-N., Liu, X.-T., Liang, Z.-H., & Wang, J.-H. (2021). Gut microbiota in obesity. *World*

Journal of Gastroenterology, 27, 3837–3850.

13-Shaffer, E. A. (2006). Epidemiology of gallbladder stone disease. *Best Practice & Research Clinical Gastroenterology, 20*, 981–996.

14-Steenackers, N., Vanuytsel, T., Augustijns, P., Tack, J., Mertens, A., Lannoo, M., … Matthys, C. (2021). Adaptations in gastrointestinal physiology after sleeve gastrectomy and Roux-en-Y gastric bypass. *Lancet Gastroenterology & Hepatology, 6*, 225–237.

15-Talha, A., Abdelbaki, T., Farouk, A., Hasouna, E., Azzam, E., & Shehata, G. (2020). Cholelithiasis after bariatric surgery: Incidence and prophylaxis in a randomized controlled trial. *Surgical Endoscopy, 34*, 5331–5337.

-16-Wang, W., Cheng, Z., Wang, Y., Dai, Y., Zhang, X., & Hu, S. (2019). Role of bile acids in bariatric surgery. *Frontiers in Physiology, 10*, 374.

17- Zhu, Q., Xing, Y., Fu, Y., Chen, X., Guan, L., Liao, F., & Zhou, X. (2023). Causal association between metabolic syndrome and cholelithiasis: A Mendelian randomization study. *Frontiers in Endocrinology, 14*, 1180903.

TABLES

Table 1. Bile Acids and Gallstone Formation After Bariatric Surgery

Parameter	(Gallstones) G A	(No Gallstones) G B	P (value)	Comments
Incidence of Gallstones	50% (48 patients)	50% (48 patients)	-	Equal distribution of gallstone cases in the study population.
Time to Gallstone Detection (days)	336.85 ± 127.81	358.02 ± 143.03	0.45	Gallstones were typically detected within the first postoperative year.
Bile Acid Dysregulation	Present	Absent	-	Impaired bile acid metabolism contributed to gallstone formation in Group A.
Rapid Weight Loss	Higher	Lower	<0.05	Rapid post-bariatric weight loss strongly correlates with gallstone occurrence.
Lipid Profiles:				
Total cholesterol levels (milligrams per deciliter)	187.0 ± 34.3	178.4 ± 31.7	0.24	Higher in Group A but not statistically significant.
LDL (milligrams per deciliter)	109.9 ± 30.2	105.5 ± 30.6	0.50	No significant difference between groups.
Triglycerides (milligrams per deciliter)	143.3 ± 81.5	122.2 ± 62.3	0.19	Elevated triglycerides in Group A may increase risk.
HDL (milligrams per deciliter)	48.8 ± 14.4	51.9 ± 14.0	0.32	No significant difference between groups.
Diabetes Prevalence (%)	20.8%	43.8%	0.02	Surprisingly, diabetes was more common in Group B, suggesting complex dynamics.
Hypertension Prevalence (%)	52.1%	39.6%	0.22	Higher in Group A, but not statistically significant.
UDCA Therapy	Reduced gallstones	Not applicable	<0.05	UDCA significantly reduced gallstone incidence in patients using it.
Dietary Modifications	Associated with reduced risk	Not applicable	-	A gallbladder-friendly diet helped lower gallstone risk.
Gradual Weight Loss	Reduced gallstone risk	Not applicable	<0.05	Gradual weight loss reduced the likelihood of gallstone formation.

Table 2. Preventive Measures

Surgery Type	Procedure Description	Impact on Bile Salts	Gallstone Formation Risk	Comments
Sleeve Gastrectomy (SG)	Removal of ~75-80% of the stomach, leaving a tubular 'sleeve.'	Minimal effect on bile salt circulation. Reduced gastric volume may promote bile stasis.	Moderate Risk	Common due to rapid weight loss; preventive strategies like UDCA or gradual weight loss can help.
(RYGB)	It changes the food eaten directly from a small gastric pouch to the jejunum, that is therefore bypassing most of the stomach and duodenum.	Substantial decrease in bile salt reabsorption due to by-passing of the proximal jejunum and duodenum.	High Risk	High rates of gallstone formation due to bile salt dysregulation and rapid weight loss.
(MGB)	Basically, it is a gastric bypass that has been made less complicated by using only one anastomosis to connect the stomach with the jejunum.	Decreased bile salt absorption via the bypass of duodenum. Bile reflux is more common.	High Risk	Increased bile reflux may exacerbate dyspepsia and bile salt imbalances.
(SASI)	Involves a sleeve gastrectomy with an ileal bypass.	Bile salt circulation is significantly altered by ileal bypass, reducing enterohepatic circulation.	Moderate to High Risk	Combining a sleeve with ileal bypass can lead to gallstone formation due to altered bile salt metabolism.
(SASJ)	Combines a sleeve gastrectomy with the bypass of the jejunum.	Alters bile salt reabsorption by bypassing the jejunum.	Moderate Risk	Reduced bile salt absorption contributes to gallstone formation.