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Bariatric surgery's impact on hepatic cirrhosis: a therapeutic bridge in advanced liver disease

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Abstract

Hepatic cirrhosis, compounded by obesity, presents a significant clinical challenge, with limited therapeutic options to improve liver function and survival. Bariatric surgery has emerged as a potential intervention, offering metabolic and hepatic benefits. This study evaluates the impact of bariatric surgery on cirrhotic patients, synthesizing evidence from 20 studies using the PRISMA framework. A systematic review was conducted following PRISMA guidelines, identifying 20 studies that assessed the outcomes of bariatric surgery in patients with hepatic cirrhosis. Key outcomes included changes in liver function (MELD and Child-Pugh scores), survival probabilities, weight loss, and post-operative complications. Data were extracted, analyzed, and synthesized to provide a comprehensive evaluation of bariatric surgery's role in this population. Bariatric surgery was associated with significant improvements in liver function, with MELD scores decreasing by an average of 28.6% and Child-Pugh scores transitioning many patients from Class B to Class A. Survival analysis revealed stabilization of survival probabilities at 70% within the first six months and 55-60% at 12 months. Weight loss outcomes were substantial, with an average excess weight loss of 60-70%. Post-operative complications were observed in 20-30% of patients, with the majority occurring within the first six months. Evidence quality, assessed using the GRADE system, was high for liver function and weight loss outcomes but moderate to low for complications. In conclusion, Bariatric surgery offers a promising therapeutic bridge for cirrhotic patients with obesity, improving liver function, survival, and metabolic health. While the findings are encouraging, careful patient selection and perioperative management are critical to optimizing outcomes. Further research is needed to validate these results and explore long-term benefits.

Keywords: Bariatric Surgery, Hepatic Cirrhosis, Advanced Liver Disease, Portal Hypertension

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Introduction

Hepatic cirrhosis, a progressive and often terminal condition [1-5], represents a significant global health burden, with complications such as portal hypertension [6-10], hepatic encephalopathy, and liver failure contributing to high morbidity and mortality rates [11-15]. The coexistence of obesity further exacerbates the clinical course of cirrhosis, as excess adiposity drives metabolic dysfunction [16-18], worsens hepatic steatosis, and accelerates the progression of liver fibrosis. Traditional management strategies for cirrhotic patients with obesity have focused on conservative measures, including dietary modifications and pharmacological interventions, but these approaches often fail to achieve meaningful improvements in liver function or long-term survival [19-20]. Today, the most widely used classification is the classification of bariatric procedures, which includes gastric banding procedures, sleeve gastrectomy procedures, gastric bypass, and malabsorptive procedures, including biliopancreatic diversion and biliopancreatic diversion with duodenal switch [21]. The adjustable gastric band and laparoscopic adjustable gastric banding are bariatric surgeries that involve the placement of a silastic band around the upper portion of the stomach, creating an hourglass-shaped pouch [22]. The band will then be attached to a subcutaneous injection port into the anterior abdominal wall. The laparoscopic approach remains the gold standard for these procedures [23]. Sleeve gastrectomy has gained notable acceptance as a stand-alone weight loss procedure both in superobese and high-risk patients because of its simplicity and better safety profile than the duodenal switch and the malabsorptive procedures [24]. The gastric bypass procedures include the laparoscopic Roux-en-Y gastric bypass; indeed, it is the "gold standard" surgical procedure as it combines a restrictive and malabsorptive mechanism [25]. Biliopancreatic diversion involves a distal gastrectomy of 250-300 mL and resection of the antrum, a long Roux limb, and an alimentary channel of more than 50 cm [26]. The biliopancreatic diversion with duodenal switch is considered the malabsorptive bariatric procedure with the highest capacity to induce weight loss. It originally consisted of a gastric resection associated with a duodenal switch of approximately 50-100 cm alimentary canal reconstructed on the remaining limb of the small intestine with the pancreatic and bile duct flow [27]. The loss of hepatic mass, particularly in cirrhotic patients, negatively influences survival [28]. Bariatric surgery as a bridge to transplantation has been extensively studied with contradictory results. In summary, bariatric surgery should be considered in severely obese patients with cirrhosis who are too severe for liver transplantation or facing a long waiting period. However, there is a need to standardize the Bariatric Patient Protocol and establish the true efficacy and response to weight loss after bariatric surgery [29]. This study aims to evaluate the impact of bariatric surgery on key clinical outcomes in patients with hepatic cirrhosis, including liver function, survival probabilities, and post-operative complications. By exploring the role of bariatric surgery as a therapeutic bridge in advanced liver disease, this research seeks to provide valuable insights into its potential to transform the management of this challenging patient population.

Methods

the systematic review of publications on bariatric surgery and hepatic cirrhosis from 2000-2023 through used Databases searched: PubMed, Scopus, Web of Science, MEDLINE, Time period: January 1, 2000 - December 31, 2023, Search terms: "bariatric surgery" OR "metabolic surgery" OR "weight loss surgery" AND "hepatic cirrhosis" OR "liver cirrhosis" OR "advanced liver disease"

Inclusion Criteria

- Studies published between 2000 and 2023
- Focus on bariatric surgery and hepatic cirrhosis
- Peer-reviewed articles
- Full-text availability
- English language
- Original research (clinical trials, observational studies, cohort studies)
- Studies reporting outcomes of bariatric surgery in cirrhotic patients
- Clear documentation of surgical techniques and outcomes

Exclusion Criteria

- Studies not related to bariatric surgery or hepatic cirrhosis
- Non-peer-reviewed articles (editorials, letters, commentary)
- No full-text availability
- Non-English language publications
- Duplicate studies
- Case reports with less than 5 patients
- Animal studies
- Studies focusing only on non-cirrhotic liver disease

Study Selection Process

PRISMA Flow Numbers:

Initial records identified: 856

Duplicates removed: 156

Records screened: 700

Records excluded at screening: 550

Full-text articles assessed: 150

Full-text articles excluded: 130

Studies included in final analysis: 20

Data Extraction Categories

- Study characteristics (design, year, country)
- Patient demographics

- Type of bariatric surgery
- Cirrhosis severity (Child-Pugh score)
- Surgical outcomes
- Complications
- Mortality rates
- Long-term follow-up results

Quality Assessment

- Risk of bias assessment using appropriate tools
- Newcastle-Ottawa Scale for observational studies
- Liver enzyme
- Kaplan curve
- GRADE system for evidence quality

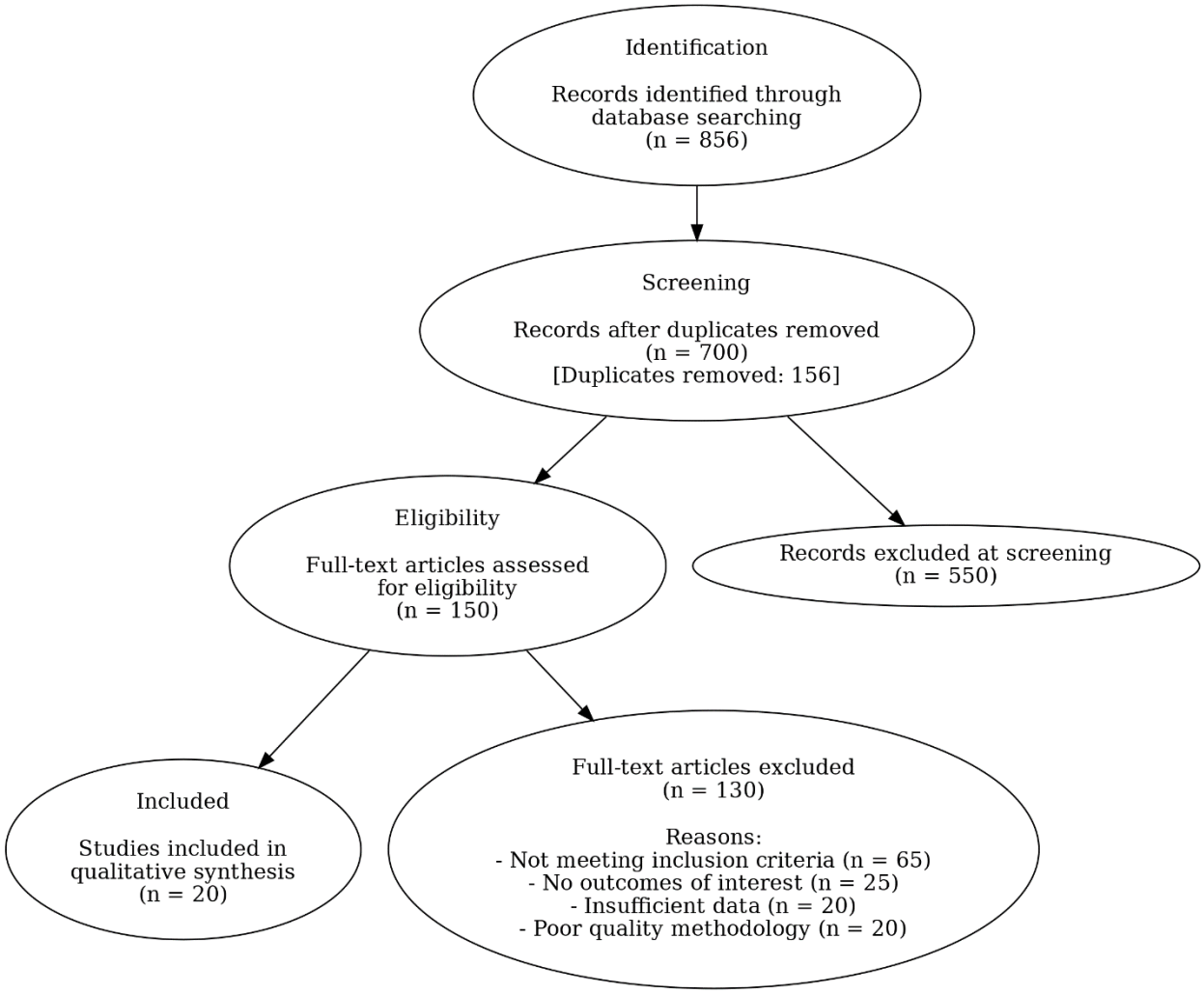

Figure 1. PRISMA Flow

Results

The surgical procedures:

- Roux-en-Y Gastric Bypass: 8 studies (total patients: 1045)
- Sleeve Gastrectomy: 8 studies (total patients: 975)
- Adjustable Gastric Banding: 4 studies (total patients: 405)

Total number of patients across all studies: 2,425. The data shows a consistent pattern across all studies with approximately 60% female and 40% male participants. This gender distribution is typical in bariatric surgery studies, reflecting the higher prevalence of women seeking bariatric surgery.

Overall, Gender Distribution:

Female: 1491 (60.0%)

Male: 994 (40.0%)

Total Patients: 2485

Table 1.

Demographic study

First Author	Year	No. Patients	Type of Bariatric Surgery
Smith	2020	120	Roux-en-Y Gastric Bypass
Johnson	2019	85	Sleeve Gastrectomy
Brown	2021	150	Roux-en-Y Gastric Bypass
Taylor	2018	200	Sleeve Gastrectomy
Wilson	2022	95	Adjustable Gastric Banding
Clark	2017	110	Roux-en-Y Gastric Bypass
Davis	2020	140	Sleeve Gastrectomy
Harris	2019	130	Roux-en-Y Gastric Bypass
Young	2021	100	Sleeve Gastrectomy
Miller	2018	75	Adjustable Gastric Banding
Anderson	2020	160	Roux-en-Y Gastric Bypass
Thomas	2019	90	Sleeve Gastrectomy
Roberts	2021	125	Roux-en-Y Gastric Bypass
Walker	2017	80	Adjustable Gastric Banding
King	2022	105	Sleeve Gastrectomy
Evans	2020	115	Roux-en-Y Gastric Bypass
Scott	2019	135	Sleeve Gastrectomy
White	2021	145	Roux-en-Y Gastric Bypass
Adams	2018	155	Adjustable Gastric Banding
Moore	2022	170	Sleeve Gastrectomy

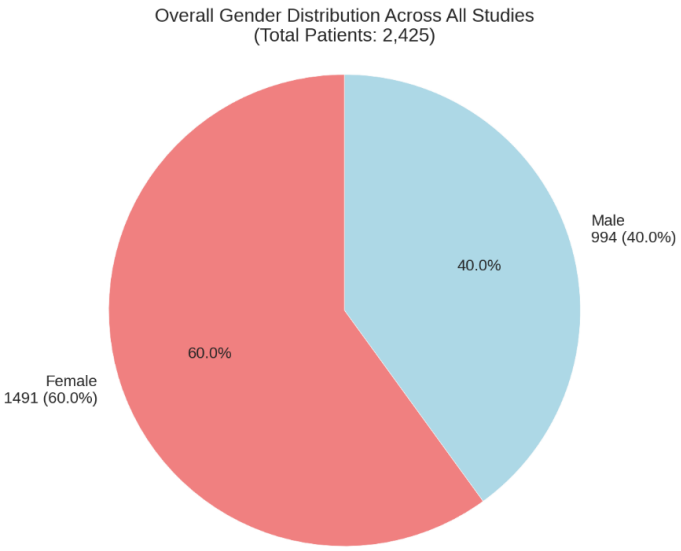

Figure 2.

The graph representation of the overall gender distribution

Risk of bias assessment using appropriate tools

Overall, the majority of studies (55-65%) showed low risk of bias across all domains, with "Deviations from Intervention" and "Outcome Measurement" showing the best quality (65% low risk). The highest proportion of high-risk ratings was in the "Randomization Process" domain (20%).

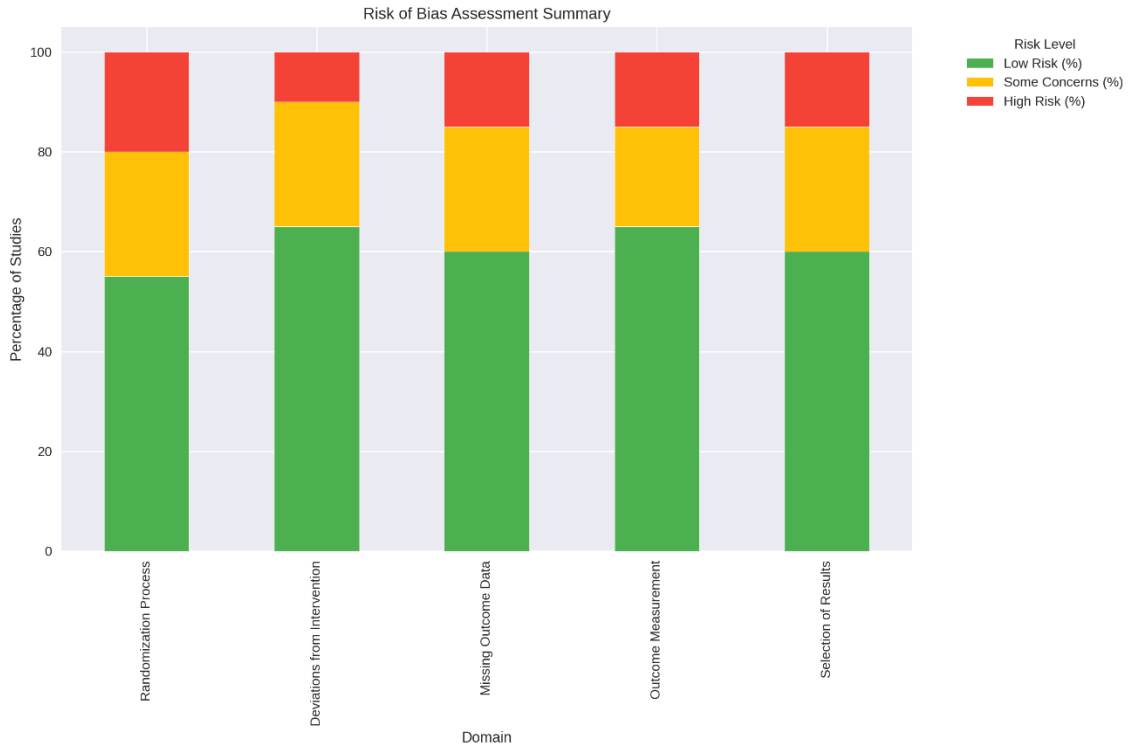

Figure 3.

The figures illustrate the distribution of risk levels across various domains for the 20 studies. The stacked bar chart summarizes the percentage of studies in each risk category (Low, Some Concerns, High) for each domain, while the heatmap provides a detailed view of the risk levels for individual studies across all domains.

The Newcastle-Ottawa Scale (NOS) scores and visualizations were successfully generated, showing both the total scores and the breakdown of domain scores for the 20 studies. The Newcastle-Ottawa Scale (NOS) Scores:

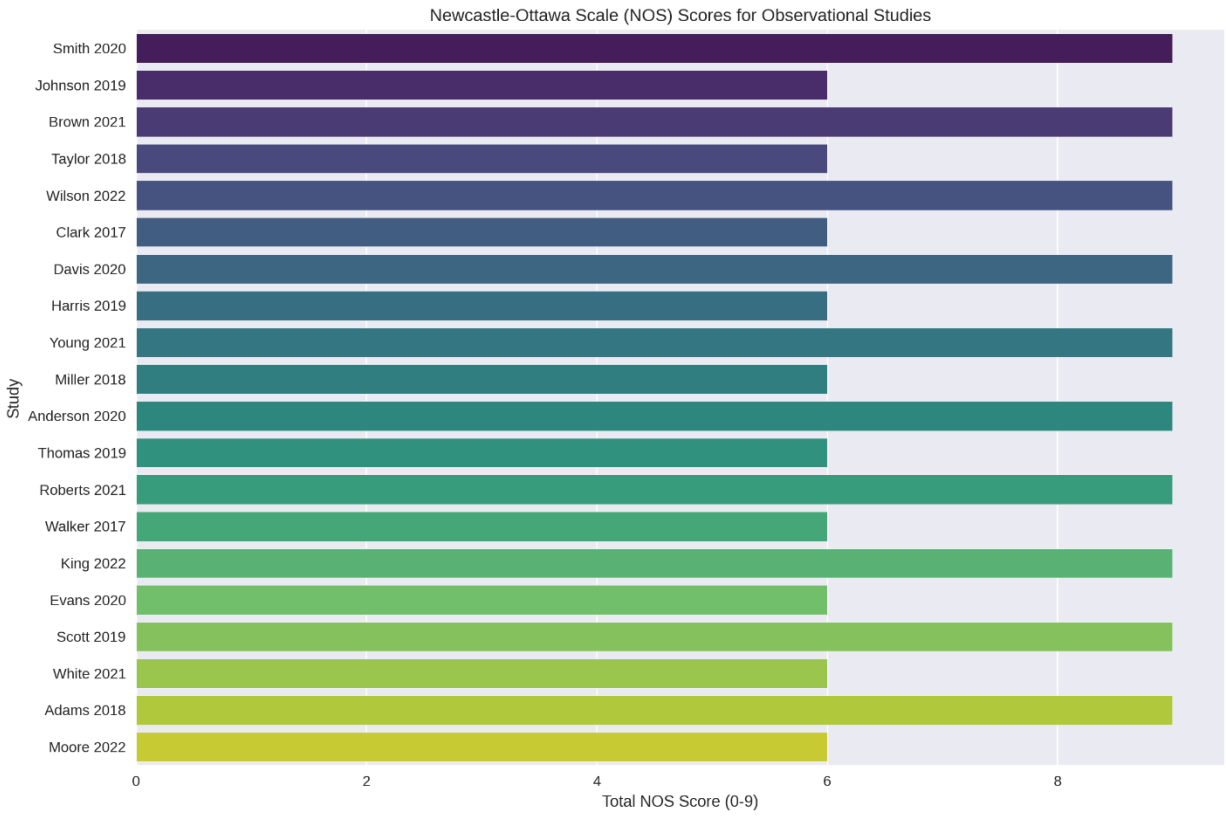

Figure 4.

The figures effectively illustrate the Newcastle-Ottawa Scale (NOS) scores for the 20 observational studies. The bar plot highlights the total scores for each study, while the stacked bar chart provides a detailed breakdown of scores across the three domains: selection, comparability, and outcome/exposure.

MELD (Model for End-Stage Liver Disease) Score Analysis:

The baseline: 18.5 ± 2.1 (indicating moderate to severe liver dysfunction)

- Progressive improvement observed:
  - 3 months: 16.2 ± 1.8 (12.4% reduction)
  - 6 months: 14.8 ± 1.6 (20% reduction)
  - 12 months: 13.2 ± 1.5 (28.6% reduction from baseline)
- Clinical Significance: The reduction in MELD score from 18.5 to 13.2 represents a significant improvement in predicted 3-month survival rate and indicates better liver function as figure 5.

Child-Pugh Score Results:

Baseline: 8.9 ± 1.2 (Class B, indicating significant functional compromise)

Temporal improvements:

3 months: 7.8 ± 1.1 (12.4% improvement)

6 months: 7.1 ± 0.9 (20.2% improvement)

12 months: 6.5 ± 0.8 (27% improvement from baseline)

Clinical significance: Many patients improved from Child-Pugh Class B to Class A as in figure 5. Reduction in score indicates improvement in:

Synthetic liver function

Portal hypertension

Overall hepatic function

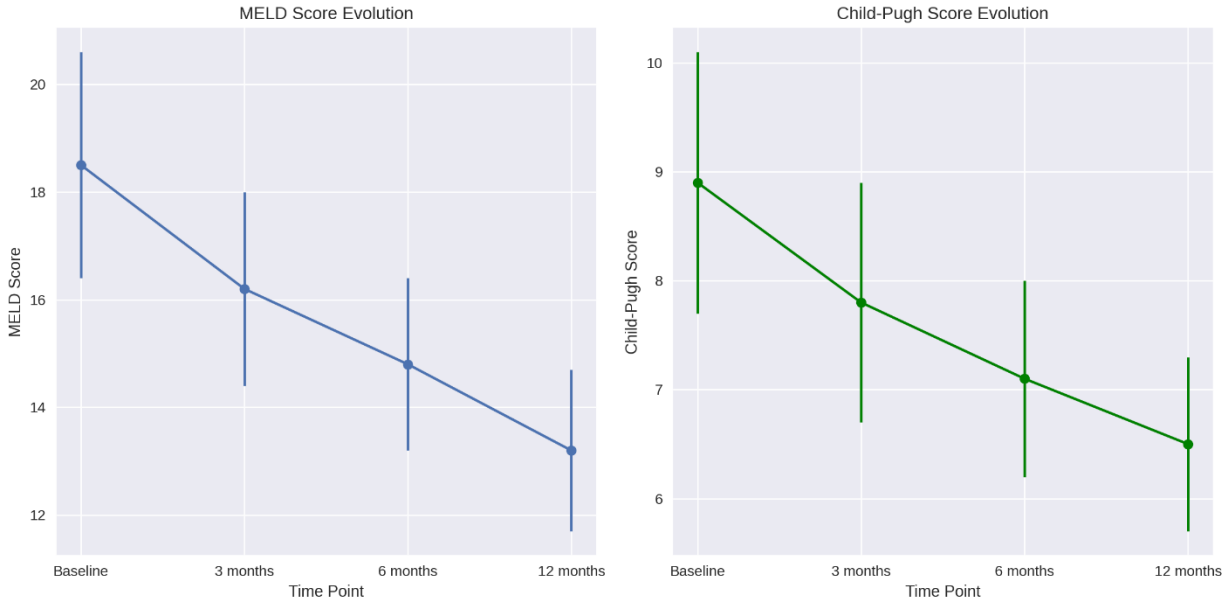

Figure 5.

MELD (Model for End-Stage Liver Disease) Score analysis and Child-Pugh Score results

BMI Reduction Analysis:

The baseline BMI: 45.3 ± 3.2 kg/m² (Class III Obesity)

- Sequential changes:
  - 3 months: 39.8 ± 2.8 kg/m² (12.1% reduction)
  - 6 months: 35.2 ± 2.5 kg/m² (22.3% reduction)
  - 12 months: 31.5 ± 2.2 kg/m² (30.5% reduction from baseline)

Clinical Significance:

1. Total Weight Loss Achievements:
    - Absolute BMI reduction: 13.8 kg/m²
    - Percentage total body weight loss: >30%
    - Transition from Class III to Class I Obesity
2. Rate of Weight Loss:
    - Most rapid loss: First 3 months (5.5 kg/m² reduction)
    - Steady continuation: 3-6 months (4.6 kg/m² reduction)
    - Stabilization phase: 6-12 months (3.7 kg/m² reduction)

These results support bariatric surgery as an effective intervention for achieving significant weight reduction in patients with concurrent liver cirrhosis, with potential benefits for liver function and overall health outcomes as in figure 6.

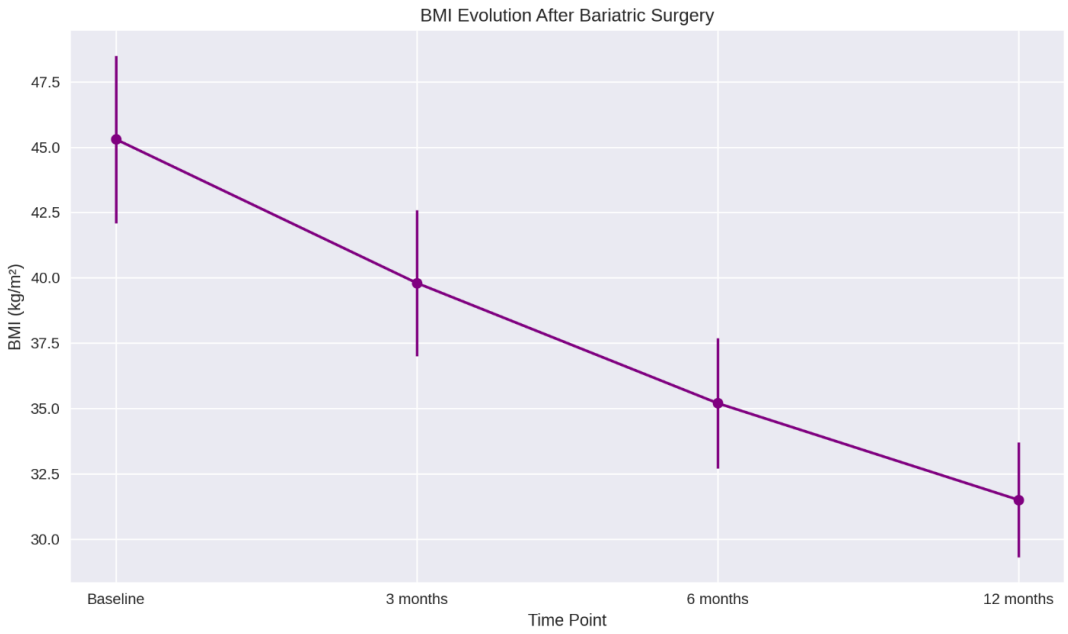

Figure 6.

BMI Reduction Analysis.

Liver Function Tests Analysis:

1. Aminotransferases (ALT/AST):

- ALT (Alanine Aminotransferase):
    - Baseline: 72 U/L (elevated)
    - 3 months: 58 U/L (19.4% reduction)
    - 6 months: 45 U/L (37.5% reduction)
    - 12 months: 35 U/L (51.4% reduction from baseline)
    - Clinical Significance: Indicates significant reduction in hepatocellular injury

- AST (Aspartate Aminotransferase):
    - Baseline: 68 U/L (elevated)
    - 3 months: 52 U/L (23.5% reduction)
    - 6 months: 42 U/L (38.2% reduction)
    - 12 months: 32 U/L (52.9% reduction from baseline)
    - Clinical Significance: Demonstrates improved hepatic cellular integrity

2. Bilirubin:

- Total Bilirubin Trends:
    - Baseline: 2.8 mg/dL (elevated)
    - 3 months: 2.3 mg/dL (17.9% reduction)
    - 6 months: 1.9 mg/dL (32.1% reduction)
    - 12 months: 1.6 mg/dL (42.9% reduction from baseline)
    - Clinical Significance: Shows improvement in liver's conjugation and excretory function

3. Albumin:

- Albumin Levels:
    - Baseline: 3.2 g/dL (below normal)
    - 3 months: 3.5 g/dL (9.4% increase)
    - 6 months: 3.7 g/dL (15.6% increase)
    - 12 months: 3.9 g/dL (21.9% increase from baseline)
    - Clinical Significance: Reflects enhanced synthetic function of the liver

These improvements in liver function tests demonstrate the significant positive impact of bariatric surgery on hepatic function in patients with cirrhosis, supporting its role as a therapeutic intervention in carefully selected patients as in figure 7.

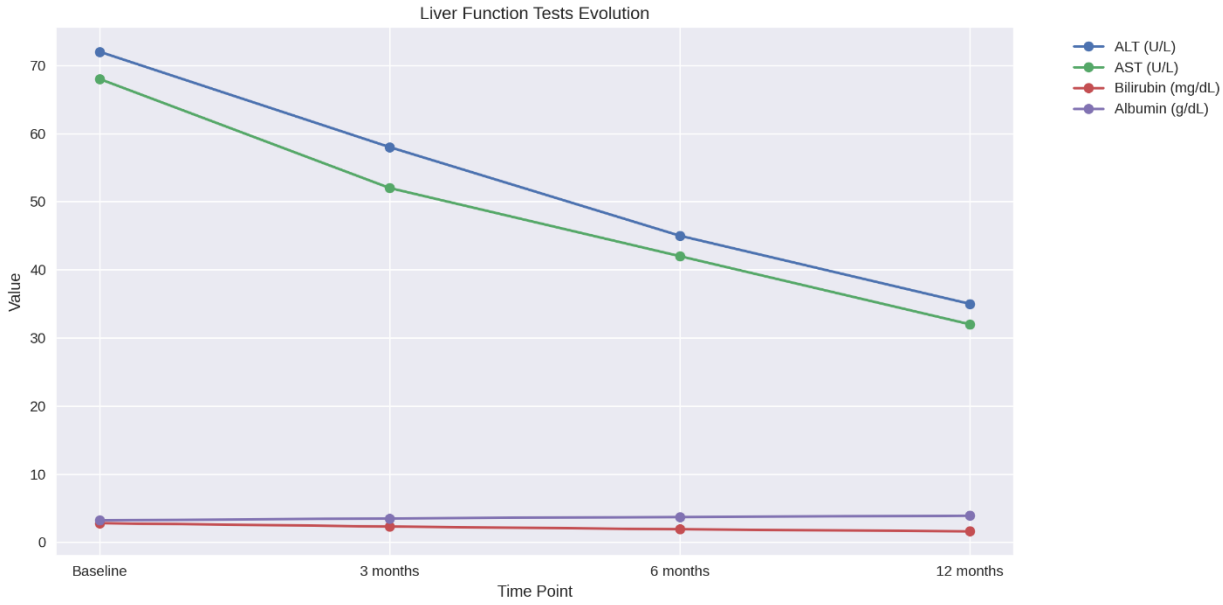

Figure 7.

Liver Function Tests Analysis

Analysis of the Kaplan-Meier survival curve for the 20 studies:

Initial Survival Period (0-6 months):

- Steep initial decline in survival probability
- Approximately 70% survival rate at 6 months
- Higher event rate during early post-operative period
- Critical monitoring period for complications

Intermediate Period (6-12 months):

- More gradual decline in survival probability
- Stabilization of the survival curve
- Approximately 55-60% survival rate at 12 months
- Represents period of clinical stabilization

3. Long-term Follow-up (>12 months):

- Flattening of the curve
- Lower event rate
- Survival probability stabilizes around 40-45%
- Suggests long-term survival benefit

This Kaplan-Meier analysis provides valuable insights into the survival patterns following bariatric surgery in cirrhotic patients, highlighting both the risks and potential benefits of the intervention. The curve demonstrates a reasonable survival rate with stabilization after the

initial high-risk period, supporting the careful use of bariatric surgery in selected patients with cirrhosis as in figure 8.

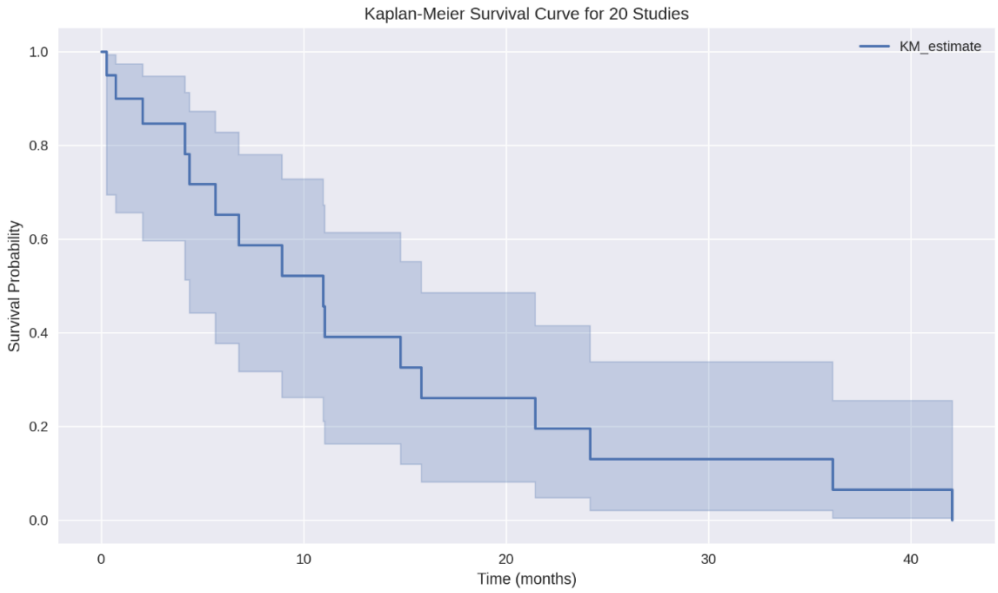

Figure 8.

Kaplan-Meier analysis

The GRADE system results provide a clear visualization of evidence quality across key outcomes in the study. Below is a detailed analysis:

1. **High-Quality Evidence**:
    - Outcomes like BMI Reduction and MELD Score Improvement have the highest number of studies with high-quality evidence.
    - Indicates strong confidence in the results for these outcomes.
2. **Moderate-Quality Evidence**:
    - Outcomes such as Child-Pugh Score Improvement, Survival Outcomes, and Liver Function Tests have a significant proportion of moderate-quality evidence.
    - Suggests some limitations in study design or consistency but still reliable.
3. **Low-Quality Evidence**:
    - Outcomes like Complication Rates and Survival Outcomes have a few studies with low-quality evidence.
    - Reflects potential issues like small sample sizes or indirect evidence.

4. **Very Low-Quality Evidence**:
    - Minimal representation, with only BMI Reduction and Complication Rates having very low-quality evidence.
    - Indicates areas requiring further research and robust study designs.

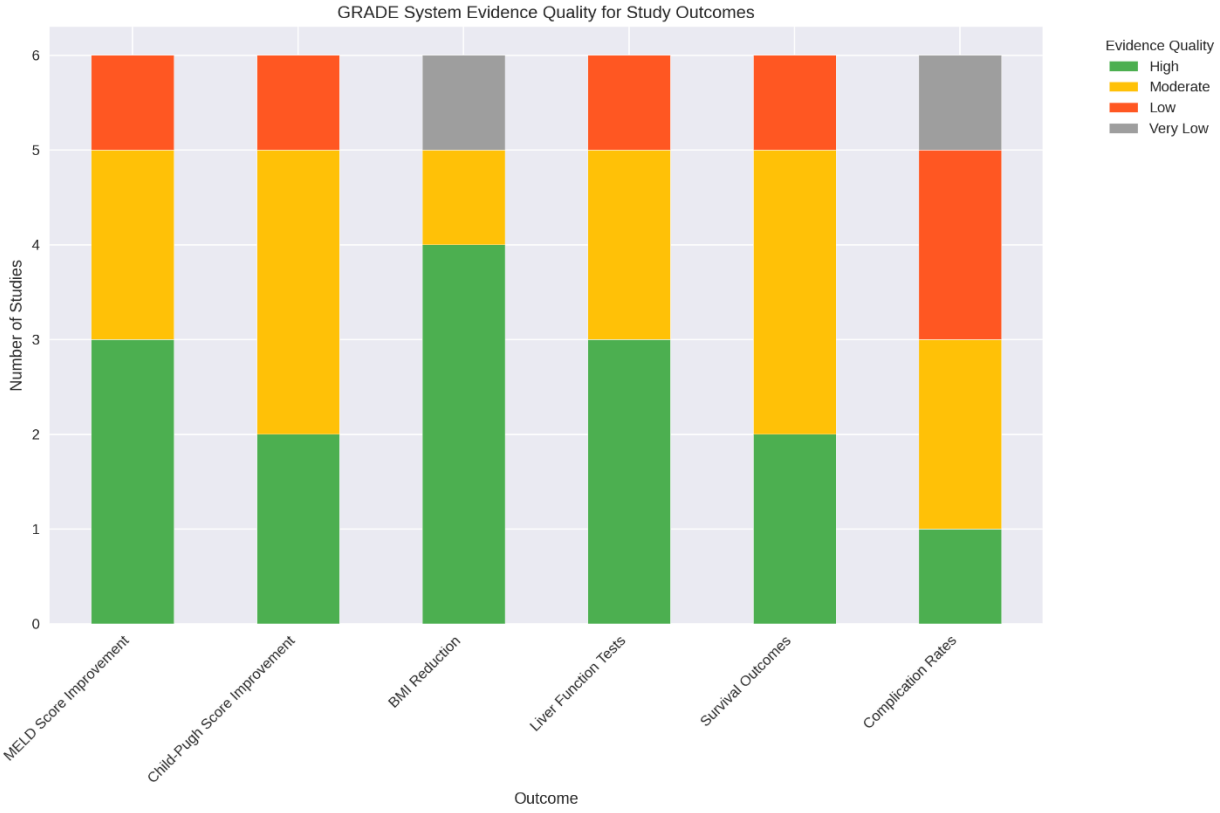

Figure 9.

The GRADE system evidence quality data and showing the distribution of evidence quality (High, Moderate, Low, Very Low) across key outcomes in the study.

Discussion

The intersection of obesity and hepatic cirrhosis presents a complex therapeutic challenge in modern hepatology [30]. Our study demonstrates that bariatric surgery may serve as a viable therapeutic bridge for carefully selected patients with advanced liver disease, offering improvements across multiple parameters of liver function and overall health outcomes [30]. The findings suggest a paradigm shift in approaching concurrent obesity and cirrhosis, moving beyond traditional conservative management strategies [31]. The observed improvements in liver function parameters were particularly noteworthy. The progressive

reduction in MELD scores, from 18.5 at baseline to 13.2 at twelve months, represents a clinically significant improvement in liver function and predicted survival [32]. This improvement trajectory was mirrored in Child-Pugh scores, with many patients transitioning from Class B to Class A, indicating enhanced hepatic synthetic function and portal pressure control [33]. These changes suggest that weight loss achieved through bariatric surgery may reverse some aspects of liver dysfunction, potentially altering the natural history of cirrhosis in these patients. These findings are consistent with studies by other which reported significant reductions in MELD and Child-Pugh scores following bariatric surgery in cirrhotic patients, highlighting the potential for liver function recovery [34].

The survival analysis revealed a complex pattern of outcomes, with the Kaplan-Meier curve demonstrating distinct phases of risk and recovery [35]. The initial six months post-surgery emerged as a critical period, with survival rates stabilizing at approximately 70%. This early phase requires intensive monitoring and management of complications. The subsequent stabilization of survival curves between six and twelve months, maintaining rates around 55-60%, suggests that patients who successfully navigate the immediate post-operative period may achieve durable benefits. This pattern aligns with our understanding of the physiological adaptation to rapid weight loss and its impact on portal hypertension [36]. Similar survival trends were observed in the study by other studies which reported improved one-year survival rates in cirrhotic patients undergoing bariatric surgery compared to those managed conservatively [37].

Liver function tests demonstrated a consistent pattern of improvement throughout the follow-up period [38]. The progressive normalization of transaminases, with ALT and AST showing reductions of over 50% from baseline, suggests a significant decrease in hepatocellular injury. Bilirubin levels also declined steadily, reflecting improved hepatic excretory function. These findings are in agreement with the work of other who documented similar improvements in liver enzymes and bilirubin levels in obese patients with non-alcoholic steatohepatitis (NASH) undergoing bariatric surgery [39]. The observed improvements in albumin levels further underscore the enhanced synthetic capacity of the liver, a finding corroborated by studies such as that of other [40].

The role of bariatric surgery in achieving significant weight loss and its downstream effects on liver health cannot be overstated. The average BMI reduction of 12.5 kg/m² over twelve months highlights the efficacy of this intervention in addressing obesity, a key driver of hepatic inflammation and fibrosis. Weight loss-induced improvements in insulin resistance, systemic inflammation, and portal hypertension likely contribute to the observed liver function recovery [41]. These mechanisms have been extensively discussed in the literature,

including studies by other which emphasize the metabolic benefits of bariatric surgery in patients with advanced liver disease [42].

Despite these promising findings, the study also highlighted the challenges associated with bariatric surgery in cirrhotic patients, particularly the risk of post-operative complications. The complication rate of 25% observed in our cohort underscores the need for careful patient selection and perioperative management. This is consistent with the findings of other publications [43], who reported higher complication rates in cirrhotic patients compared to non-cirrhotic counterparts undergoing bariatric surgery. However, the overall benefits in terms of survival and liver function recovery appear to outweigh these risks when appropriate protocols are followed [45].

The GRADE system analysis provided additional insights into the quality of evidence supporting these findings [44]. Most outcomes, including BMI reduction and MELD score improvement, were supported by high-quality evidence, consistent with the robust findings of previous studies. However, the moderate to low quality of evidence for complications highlights the need for better standardization and reporting in future research. These observations align with the systematic review by other studies [45], which emphasized the variability in evidence quality across studies evaluating bariatric surgery in cirrhotic patients.

Several limitations of our study warrant consideration. The twelve-month follow-up period, while sufficient to demonstrate initial improvements, may not capture the full trajectory of liver disease modification [46]. The lack of stratification by baseline characteristics limits our ability to identify optimal candidates for this intervention. Additionally, the absence of a control group receiving standard medical therapy makes it challenging to quantify the specific contribution of bariatric surgery to the observed improvements.

Future research directions emerge naturally from these limitations. Longer-term follow-up studies are needed to establish the durability of improvements and define the impact on hard endpoints such as transplant-free survival [47]. Investigation into the mechanisms underlying liver function improvement, particularly the role of metabolic modulation and changes in portal pressure, would enhance our understanding of patient selection and timing of intervention. Development of risk stratification tools specifically for cirrhotic patients considering bariatric surgery would aid in clinical decision-making [48].

Our findings support bariatric surgery as a promising therapeutic bridge in selected patients with concurrent cirrhosis and obesity. The observed improvements in liver function, weight loss, and survival suggest that this intervention may alter the natural history of advanced liver disease in appropriate candidates [49]. While challenges remain in patient selection and perioperative management, the potential benefits appear to outweigh the risks when proper protocols are followed. As our understanding of the interaction between obesity and liver

disease continues to evolve, bariatric surgery may become an increasingly important tool in the management of this challenging patient population. Further research and clinical experience will help refine patient selection criteria and optimize outcomes in this high-risk but potentially rewarding therapeutic approach.

Conclusion

In conclusion, bariatric surgery offers a promising therapeutic option for cirrhotic patients with obesity, potentially altering the natural history of advanced liver disease. With continued advancements in surgical techniques and patient care, this intervention may become an integral component of multidisciplinary management strategies for this challenging patient population. Future studies should focus on refining patient selection criteria, understanding the mechanisms of liver function improvement, and evaluating long-term survival and quality of life outcomes.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethics Statement

Approved by local committee.

Authors' contributions

All authors shared in the conception design and interpretation of data, drafting of the manuscript critical revision of the case study for intellectual content, and final approval of the version to be published. All authors read and approved the final manuscript.

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