Perioperative screening for metabolic dysfunction associated steatotic liver disease in people undergoing bariatric surgery: a pilot study

Key Points

- This study aimed to determine the feasibility of perioperative liver assessment
- Valid non-invasive test scores were achieved in all participants preoperatively
- There were reductions in measures of hepatic steatosis and fibrosis postoperatively
- Perioperative liver fibrosis screening using non-invasive tests is feasible

Introduction

Guidance advocates for perioperative assessment of advanced liver fibrosis in bariatric surgery patients (1, 2), given 1 in 5 have significant fibrosis secondary to metabolic dysfunction-associated steatotic liver disease (MASLD) (3). The presence of complications, such as portal hypertension, may impact perioperative outcomes (4). Identification of liver fibrosis informs surgical decision making and therapy. Importantly, cirrhosis does not preclude surgical intervention, and bariatric surgery can resolve MASLD-related fibrosis (1, 2, 4).

In our practice, perioperative MASLD assessment is not undertaken. We examined whether perioperative MASLD screening was feasible, and the impact of these additional assessments on hepatology referrals.

Methods

Study design

This work was an approved service evaluation project by Swansea Bay University Health Board. Additional liver assessment was offered to all eligible bariatric surgery patients preoperatively and postoperatively. Participants with moderate or advanced fibrosis (transient elastography-liver stiffness measure (TE-LSM) ≥8.2kPa) were discussed with hepatology. Figure 1 presents the study design.

Participants

Participants were aged ≥18 years, with body mass index ≥40kg/m^2 or ≥35kg/m^2 and obesity-related comorbidity. Recruitment was July-November 2023, and follow-up March-August 2024.

Data collection

Participants had a valid TE-LSM score if ≥10 scans were achieved with interquartile range/median ratio <30%. Figure 1 presents thresholds defining hepatic steatosis and fibrosis. Participants provided feedback using a standardised questionnaire.

Statistical analysis

Analysis was undertaken using SPSS (version 29). Categorical data are presented by number (%). Normality was assessed by Kolmogorov-Smirnov test and visualised using Q-Q plots. Normally distributed data are presented by mean±standard deviation. Significance of changes in data was assessed by paired t-test. Correlations were determined by Pearsons's correlation coefficient, significant at $p<0.01$.

Results

Participant characteristics

Twenty-two individuals participated (Table 1); all had valid TE and blood-based biomarkers.

Perioperative findings

Preoperatively, TE indicated moderate and severe steatosis in 4 (18.2%) and 10 (45.4%) participants, respectively, with moderate and advanced fibrosis in 1 (4.6%) and 11 (50.0%). Using the APRI, FIB-4 score and NFS, 0 (0.0%), 1 (4.6%) and 12 (54.6%) had risk for advanced fibrosis.

At 7.2±1.7 months, 18 (81.8%) underwent repeat TE. All had valid TE, and 17 (94.4%) had blood-based biomarkers. Of the 4 without repeat TE, 1 declined due to relocation, 1 due to cancer diagnosis, 1 missed several appointments, and 1 did not undergo surgery.

At follow-up, 15 (83.3%) had lower TE-controlled attenuation parameter (CAP), 16 (88.9%) had lower TE-LSM. Of the 2 (11.1%) with greater post-operative TE-LSM, 1 required hepatology referral following Roux-en-Y gastric bypass (TE-LSM=10.8kPa). Figure 2 presents changes in frequency of significant steatosis and fibrosis. Using the APRI, FIB-4 score and NFS, 0 (0.0%), 1 (5.6%), and 6 (33.3%) had risk of advanced fibrosis, respectively. Using TE, 11 (61.1%) required preoperative discussion and 7 (38.8%) required referral postoperatively (p=0.18).There were changes in several characteristics over follow-up (Table 2). However, blood-based biomarkers and TE-LSM did not correlate significantly neither preoperatively, nor postoperatively (Table 3).

Patient feedback

All 22 participants felt TE was an acceptable test and would agree to undergo future repeat assessments. All participants reported they understood the result and reasons for the scan. One (4.6%) felt TE was painful, two (9.1%) reported TE took longer than anticipated.

Discussion

Perioperative screening for advanced fibrosis using blood tests and TE during bariatric surgery was feasible. All-but-one participant had valid blood-based biomarkers, and all had valid TE scores. Obesity reduces the accuracy of the APRI, NFS, and TE-CAP in predicting steatosis, whilst FIB-4 and TE-LSM scores retain accuracy and are recommended in this group (1, 2, 5, 6). Here, the FIB-4 score identified only 1 at risk of advanced fibrosis pre-operatively and post-operatively. The former recorded the highest TE-LSM, the latter recorded normal preoperative but markedly increased postoperative TE-LSM. Therefore, the FIB-4 identified the most significant cases using recommended thresholds. However, previous studies indicate lower cut-offs may be needed in people with obesity, as traditional cut-offs may miss patients with advanced fibrosis (7). Nonetheless, the absence of correlation between the FIB-4 score and TE is concerning, warranting further investigation. Nonetheless, screening with imaging such as computed tomography is not appropriate given the radiation exposure, and magnetic resonance imaging is time-consuming and expensive (8). Our findings highlight the need to consider postoperative screening, recognising the emergence of TE-LSM and FIB-4 abnormalities after surgery in 1 participant. In this participant, abdominal imaging, biochemical investigation and gastroenterology review revealed no other cause of liver dysfunction. Worsening hepatic fibrosis post-bariatric surgery occurs in 1 in 8 people in previous studies (9), and in this study greater TE-LSM was seen in 2/18 (11.1%) participants.

There were significant reductions in non-invasive measures of steatosis (TE-CAP) and fibrosis (TE-LSM), and a trend to reduced hepatology referral. Given the small cohort size and lack of biopsy data, conclusions around MASLD prevalence and the impact of bariatric surgery on MASLD are limited, though previous studies consistently demonstrate the hepatic benefits of bariatric surgery (10). Extending the study with more participants or other tests (e.g. enhanced liver fibrosis test) may permit further conclusions, and discussion on the impact of screening on surgical decision making. Most found TE acceptable and understandable. Larger and qualitative studies in bariatric surgical patients may identify further themes.

Author Statements

Conflict of interest statement

The authors declare that they have no conflict of interest.

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Ethical approval and consent

This pilot study was a prospectively approved service evaluation project by Joint Study Review Committee at Swansea Bay University Health Board. Ethical approval was not required. All participants provided verbal consent to take part in this study.

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Figure legends

Figure 1: Study design

Figure 1 presents the pilot study design, and thresholds to define hepatic steatosis and fibrosis. Abbreviations: *APRI* aspartate transaminase-to-platelet ratio index; *CAP* controlled attenuation parameter; *FIB-4* fibrosis-4; *LSM* liver stiffness measure; *NFS* non-alcoholic fatty liver disease fibrosis score; *SBUHB* Swansea Bay University Health Board; *TE* transient elastography.

Figure 2: Perioperative changes in hepatic steatosis and fibrosis on transient elastography

Figure 2 presents the changes in frequency of participants with different degrees of (a) hepatic steatosis defined using TE-CAP, and (b) hepatic fibrosis defined using TE-LSM. Light grey colour represents those with a normal score, dark grey colour indicates moderate steatosis or fibrosis, and black colour indicates severe steatosis or advanced fibrosis . Participants without paired pre- and postoperative tests are not presented.

Tables

Table 1: Preoperative participant characteristics

Characteristic	**Total cohort (n=22)**
Age (years)	44.8±11.6
Female/Male sex	18 (81.8%)/4 (18.2%)
Diagnosis of T2D	15 (68.2%)
Weight (kg)	129.8±24.7
BMI (kg/m^2)	45.0±6.5
Surgery undertaken:	
LSG	12 (54.5%)
LRYGB	9 (40.9%)
Awaiting surgery	1 (4.6%)
TE–CAP (dB/m)	321.2±61.3
TE–LSM (kPa)	11.2±7.2
ALT (U/L)	37.7±27.8
ALP (U/L)	81.2±26.8
AST (U/L)	26.9±12.0
GGT (U/L)	45.4±22.7
Platelets (x10^9/L)	307.5±86.1
TC (mmol/L)	4.9±1.0
LDL (mmol/L)	2.6±0.9
HDL (mmol/L)	1.2±0.3
TG (mmol/L)	1.9±1.0
HbA1c (mmol/mol)	50.0±17.9
AST:ALT ratio	0.9±0.3
APRI	0.3±0.1
BARD score	2.9±0.9
FIB-4 score	0.7±0.3
NFS	-1.5±1.8

Table 1: Participant characteristics of those included in this pilot study. Abbreviations: *ALP* alkaline phosphatase *ALT* alanine transaminase; *APRI* aspartate transaminase-to-platelet ratio index; *AST* aspartate transaminase; *BARD* BMI-AST/ALT ratio-diabetes mellitus; *BMI* body mass index; *CAP* controlled attenuation parameter; *FIB-4* fibrosis-4; *GGT* gamma-glutamyl transferase; *HDL* high-density lipoprotein; *LRYGB laparoscopic Roux-en-Y gastric bypass; LSG* laparoscopic sleeve gastrectomy; *LDL* low-density lipoprotein; *LSM* liver stiffness measure; *NFS* non-alcoholic fatty liver disease fibrosis score; *T2D* type 2 diabetes; *TC* total cholesterol; *TE* transient elastography; *TG* triglyceride.

Table 2: Changes in non-invasive measures of MASLD over follow-up

Characteristic	Preoperative (n=18)	Postoperative (n=18)*	Significance
Weight (kg)	134.7±23.9	104.7±21.7	<0.001
BMI (kg/m^2)	46.1±5.6	35.9±6.3	<0.001
TE–CAP (dB/m)	329.8±59.7	289.7±61.7	<0.01
TE–LSM (kPa)	12.0±7.6	7.8±4.0	<0.01
ALT (U/L)	35.9±22.2	21.3±9.7	<0.05
ALP (U/L)	80.6±24.6	89.1±19.8	NS
AST (U/L)	29.5±12.5	20.7±12.1	<0.05
GGT (U/L)	43.5±21.9	26.9±15.7	<0.001
Platelets ($x10^9$/L)	299.4±78.1	265.0±66.7	<0.01
TC (mmol/L)	4.9±1.0	4.6±0.8	NS
LDL (mmol/L)	2.6±0.9	2.5±0.9	NS
HDL (mmol/L)	1.2±0.3	1.2±0.2	NS
TG (mmol/L)	1.9±1.0	1.5±0.6	<0.05
HbA1c (mmol/mol)	48.4±18.7	38.8±10.7	<0.01
APRI	0.3±0.1	0.3±0.1	NS
AST:ALT ratio	1.0±0.3	1.1±0.4	NS
BARD score	3.0±0.9	3.2±0.7	NS
FIB-4 score	0.8±0.3	0.8±0.4	NS
NFS	-1.4±1.8	-1.9±1.4	NS

Table 2: Paired changes in continuous variables observed over follow-up. *Indicates missing 1 patient data for AST, APRI, AST:ALT ratio, BARD score, FIB-4 score and NFS at the post-operative visit. Abbreviations: *ALP* alkaline phosphatase *ALT* alanine transaminase; *APRI* aspartate transaminase-to-platelet ratio index; *AST* aspartate transaminase; *BARD* BMI-AST/ALT ratio-diabetes mellitus; *BMI* body mass index; *CAP* controlled attenuation parameter; *FIB-4* fibrosis-4; *GGT* gamma-glutamyl transferase; *HDL* high-density lipoprotein; *LDL* low-density lipoprotein; *LSM* liver stiffness measure; *NFS* non-alcoholic fatty liver disease fibrosis score; T2D type 2 diabetes; *TC* total cholesterol; *TE* transient elastography; *TG* triglyceride.

Table 3: Correlations between blood-based biomarkers for hepatic fibrosis and TE-LSM

Preoperative (n=22)		
	Pearson correlation	**Significance**
ALT	r=0.21	p=0.36
AST	r=0.12	p=0.59
APRI	r=0.29	p=0.19
AST:ALT ratio	r=-0.30	p=0.18
BARD score	r=-0.34	p=0.12
FIB-4 score	r=0.17	p=0.46
NFS	r=0.30	p=0.18
Postoperative (n=17)		
	Pearson correlation	**Significance**
ALT	r=0.13	p=0.62
AST	r=0.11	p=0.67
APRI	r=0.12	p=0.65
AST:ALT ratio	r=-0.10	p=0.71
BARD score	r=0.19	p=0.47
FIB-4 score	r=0.23	p=0.37
NFS	r=0.08	p=0.77

Table 3: Correlations between blood-based biomarkers to predict fibrosis and the TE-LSM. Abbreviations: *ALT* alanine transaminase; *APRI* aspartate transaminase-to-platelet ratio index; *AST* aspartate transaminase; *BARD* BMI-AST/ALT ratio-diabetes mellitus; *FIB-4* fibrosis-4; *NFS* non-alcoholic fatty liver disease fibrosis score.

All eligible patients attending pre-assessment clinic for bariatric surgery in SBUHB were offered additional blood tests. The APRI, FIB-4 score, and NFS were calculated, and TE (Fibroscan) was also performed.

↓

Feasibility of each test was defined as the proportion of participants with results available. If a participant was found to have moderate or advanced fibrosis on TE*, the case was discussed with hepatology.

↓

Repeat liver assessment was taken 6-12 months post-operatively. Participants with ongoing moderate or advanced hepatic fibrosis on TE* were referred to hepatology for further evaluation and management.

Hepatic steatosis was defined by the TE-CAP score:

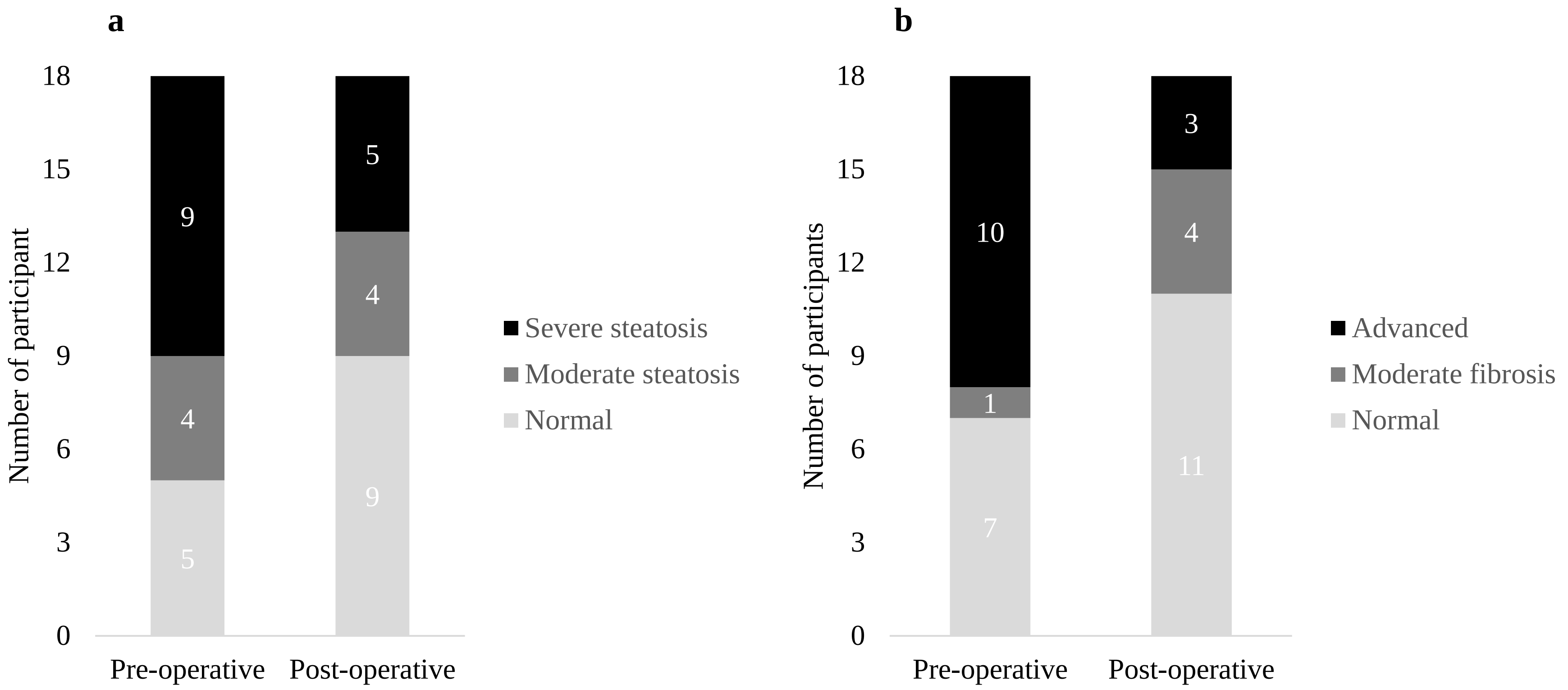
- <302 dB/m: **Normal**
- 302-337 dB/m **Moderate**
- ≥337 dB/m **Severe**

*Hepatic fibrosis was defined by the TE-LSM score:

- <8.2 kPa: **Normal**
- 8.2-9.7 kPa: **Moderate**
- ≥9.7 kPa: **Advanced**

A clinically significant risk of advanced fibrosis was defined by the following test scores:

- APRI ≥0.70,
- FIB-4 score ≥1.30,
- NFS ≥-1.455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Number of participant
Number of participants
18
15
12
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11
Severe steatosis
Moderate steatosis
Normal
Advanced
Moderate fibrosis
Normal
Pre-operative
Post-operative