# A Prospective, Blinded Comparison of Laparoscopic Ultrasound with Transabdominal Ultrasound for the Detection of Gallbladder Pathology in Morbidly Obese Patients

Shanu N Kothari, MD, FACS, Kosisochi M Obinwanne, MD, Matthew T Baker, MD, FACS, Michelle A Mathiason, MS, Kara J Kallies, MS

**BACKGROUND:** Transabdominal ultrasound (TAU) is the gold standard for detecting cholelithiasis. Morbid obesity can inhibit detection of gallbladder pathology due to increased subcutaneous and visceral fat. Laparoscopic ultrasound (LUS) has the potential to overcome these technical challenges. We hypothesized that LUS would have a sensitivity and specificity similar to TAU for detecting cholelithiasis and polyps in morbidly obese patients presenting for laparoscopic Roux-en-Y gastric bypass.

**STUDY DESIGN:** After Institutional Review Board approval, patients underwent preoperative TAU and intraoperative LUS during laparoscopic Roux-en-Y gastric bypass. Certified ultrasonographers performed all TAUs. Surgeons, blinded to TAU results, performed the LUS. Presence of cholelithiasis or polyps and common bile duct diameter was evaluated. Statistical analysis included chi-square and McNemar's test.

**RESULTS:** Two hundred and fifty-three patients were prospectively enrolled during a 6-year period. Seventy-six percent were female, mean age and preoperative body mass index (calculated as $kg/m^2$) were 43.5 years and 48, respectively. Mean time to complete the LUS was 4 minutes. Mean common bile duct diameter measured 3.7 mm via LUS and 4.0 mm via TAU. Transabdominal ultrasound and LUS identified 61 and 60 patients with cholelithiasis, respectively ($p = 0.763$). The sensitivity and specificity of LUS for cholelithiasis was 90.2% and 97.4%. Laparoscopic ultrasound identified polyps in 41 patients, and TAU identified polyps in 6 patients, 5 of which had polyps identified on LUS as well ($p < 0.001$). Sensitivity and specificity of LUS for polyps was 83.3% and 85.4%.

**CONCLUSIONS:** Laparoscopic ultrasound is equivalent to TAU in detecting cholelithiasis, however, LUS detected significantly more polyps. Intraoperative LUS is an appropriate alternative to TAU in patients undergoing laparoscopic Roux-en-Y gastric bypass. (J Am Coll Surg 2013;216:1057–1062. © 2013 by the American College of Surgeons)

Morbidly obese patients have a higher propensity for cholelithiasis than their leaner counterparts.[1-3] Patients undergoing Roux-en-Y gastric bypass can have a 22% risk of gallstones developing at 12-month follow-up.[4] In other studies, this risk has been found to be as high as 52.8%.[5] This increased risk has been attributed to cholesterol supersaturation in bile, shortened nucleation time, and gallbladder hypomotility.[6] The presence of gallstones

**CME questions for this article available at http://jacscme.facs.org**

**Disclosure Information: Authors have nothing to disclose. Timothy J Eberlein, Editor-in-Chief, has nothing to disclose.**

ClinicalTrials.gov identifier: NCT00971750.

Grant support provided by the Foundation for Surgical Fellowships for the Minimally Invasive Bariatric Surgery and Advanced Laparoscopy Fellowship.

Presented at the American College of Surgeons 98th Annual Clinical Congress, Chicago, IL, October 2012.

Received November 30, 2012; Revised February 11, 2013; Accepted February 12, 2013.

From the Department of General and Vascular Surgery, Gundersen Lutheran Health System (Kothari, Baker) and Departments of Medical Education (Obinwanne) and Surgery Research (Mathiason, Kallies), Gundersen Lutheran Medical Foundation, La Crosse, WI.

Correspondence address: Shanu N Kothari, MD, FACS, Department of General and Vascular Surgery, Gundersen Lutheran Health System, 1900 South Ave, C05-001, La Crosse, WI 54601. email: snkothar@gundluth.org





ISSN 1072-7515/13/$36.00
http://dx.doi.org/10.1016/j.jamcollsurg.2013.02.009

**Abbreviations and Acronyms**

CBD = common bile duct
EUS = endoscopic ultrasound
LRYGB = laparoscopic Roux-en-Y gastric bypass
LUS = laparoscopic ultrasound
TAU = transabdominal ultrasound

can eventually lead to problems such as cholecystitis, symptomatic cholelithiasis, choledocholithiasis, and gallstone pancreatitis. A long history of gallstones and gallbladder polyps can also be associated with a predilection to development of gallbladder cancer.[7]

The impact and management of gallbladder pathology in the bariatric population remains a relevant but controversial topic with varying opinions among experts.[8,9] For surgeons who perform a concomitant cholecystectomy with gastric bypass, it becomes pertinent to determine the presence of gallbladder pathology either preoperatively or intraoperatively. Diagnostic modalities that have been used include transabdominal ultrasonography, CT cholecystography, and laparoscopic ultrasound (LUS).

Historically, transabdominal ultrasound (TAU) has been known to be a limited modality in the evaluation of the morbidly obese patient.[10] This is mostly because both the depth of subcutaneous tissue and the increased distance to the gallbladder can deter adequate visualization of gallbladder pathology.[11,12] In this regard, we sought to investigate the role of LUS in this patient population. We hypothesized that LUS would have a sensitivity and specificity similar to TAU for detecting gallbladder pathology in morbidly obese patients.

## METHODS

Our institution is a 325-bed integrated multispecialty group health system serving 19 counties over a 3-state region. There is an accredited general surgery residency program and an accredited minimally invasive bariatric surgery and advanced laparoscopy fellowship. Additionally, our institution is a Bariatric Surgery Center of Excellence, accredited by the American Society for Metabolic and Bariatric Surgery and given Level 1a designation by the American College of Surgeons. After receiving Institutional Review Board approval, patients were prospectively enrolled from February 2004 through October 2010. All patients met the National Institute of Health criteria for bariatric surgery.[13] Inclusion criteria consisted of patients without a surgical history of cholecystectomy. Informed consent was obtained before enrollment. A preoperative TAU was obtained within 30 days before laparoscopic Roux-en-Y gastric bypass (LRYGB). All TAUs were performed by Registered Medical Diagnostic Sonographers on fasting patients. Images included pancreas, aorta, liver, gallbladder (supine and left lateral decubitus), common hepatic duct, common bile duct (CBD), and bilateral kidneys using an Acuson Sequoia (Siemens Medical Engineering Group) with a C5 or V4 probe, Philips IU-22 (Koninklijke Philips Electronics NV) with a C5 probe, or General Electric Logiq E9 (General Electric Company) with a C1-5 or C2-5 probe. TAU probe frequencies ranged from 2 to 5 MHz.

The 2 surgeons (SNK and MTB) who performed the LRYGB and LUS were blinded to the results of the TAU. At the start of study enrollment, one of the surgeons (SNK) had performed approximately 93 LUSs. The second surgeon (MTB) completed our institution's fellowship program and was involved in approximately 120 LUSs during the fellowship year. The LRYGB was performed in a retro-colic, retro-gastric fashion with a linear-stapled gastrojejunostomy. All images were obtained using the ATL 5000 (Koninklijke Philips Electronics NV) with L9 intraoperative probe at a frequency between 5 and 9 MHz. The probe was introduced through either the umbilical 12-mm port or the right upper quadrant 12-mm port. The liver was then scanned for transhepatic views of the gallbladder. The probe was placed directly on the fundus, body, and neck of the gallbladder. It was also placed on the hepatoduodenal ligament to assess the CBD diameter. Laparoscopic ultrasound images were interpreted by the surgeon, with an ultrasonographer available for assistance as needed.

The presence of cholelithiasis, sludge, gallbladder polyps, and the CBD diameter were all assessed. Cholelithiasis was defined as the presence of an intraluminal echogenic foci that cast an acoustic shadow and was gravity-dependent. Sludge was defined as low-amplitude, nonshadowing echoes that tended to layer in the most dependent portion of the gallbladder and moved slowly when the patient's position was changed. Gallbladder polyps were defined as nonmobile, nonshadowing echogenic structures attached to the gallbladder wall.[14]

No concomitant cholecystectomies were performed. All patients were given a prescription for ursodiol 300 mg orally twice daily for 6 months postoperatively. Routine follow-up office visits were conducted at 3 weeks, 3 months, 6 months, 9 months, 12 months, 18 months, 24 months and annually thereafter. Patients found to have gallbladder polyps were offered annual ultrasound scans.

Results of the 2 studies were analyzed using chi-square and $2 \times 2$ contingency tables. McNemar's test was used to analyze the difference in sensitivities between the paired studies. The $\kappa$ coefficient was computed to determine statistical nonrandom concordance between the 2 techniques. This was considered poor if the coefficient