

# Accuracy of Resident-Performed Right Upper Quadrant Ultrasonography

T Jang, C Aubin, R Naunheim

## Citation

T Jang, C Aubin, R Naunheim. *Accuracy of Resident-Performed Right Upper Quadrant Ultrasonography*. The Internet Journal of Emergency Medicine. 2002 Volume 1 Number 2.

## Abstract

**Objective:** The purpose of this study was to assess the accuracy of emergency medicine resident (EMR) performed RUQ ultrasonography (US) in the diagnosis of gallstones and acute cholecystitis.

**Methods:** This was a retrospective review of patients with suspected gall bladder pathology who underwent EMR-performed RUQ US prior to gold standard evaluation consisting of operative or department of radiology evaluation.

**Results:** 148 patients were included, 66 of whom had gallstones. EMR-performed RUQ US had a sensitivity of 95.5% (95% CI (86.4-98.8%)) and specificity of 90.2% (95% CI (81.2-95.4%)) for gallstones. 14 patients had acute cholecystitis. EMR-performed RUQ US had a sensitivity of 92.9% (95% CI (64.2-99.6%)) and specificity of 93.3% (95% CI (87.3-96.7%)) for acute cholecystitis.

**Conclusions:** EMRs can accurately perform RUQ US to diagnose gallstones and acute cholecystitis in selected patients, which was not previously established.

## INTRODUCTION

It is estimated that 16-20 million Americans have gallstones, resulting in 500,000 operations per year (1). The accurate diagnosis of gallstones and/or cholecystitis is necessary given the increased mortality risk due to cholecystitis (1). Radiographic imaging has, thus, become standard of care in the evaluation of suspected biliary pathology, including ultrasonography (US), computed tomography (CT), and HIDA scans depending on institution and physician preference (2).

Four prior studies have shown that well-trained EPs could accurately perform RUQ US in selected patients (3,4,5,6), but none have evaluated the performance of emergency medicine resident (EMR) performed RUQ US. The purpose of this study was to assess the accuracy of EMR-performed RUQ US in the diagnosis of gallstones and acute cholecystitis.

## MATERIALS AND METHODS

This was a retrospective review of patients presenting to an urban, academic ED with abdominal pain that was

suspicious for gallstones or acute cholecystitis. Those who underwent EMR-performed RUQ US prior to operative treatment or department of radiology evaluation were included. Patients triaged by nursing staff to a walk-in urgent care were not included in this study and those with EMR-performed RUQ US after evaluation by the department of radiology were excluded.

Standardized data forms included in patient files were reviewed using a predesigned data sheet. These forms included documentation of (1) a sonographic Murphy's sign, (2) the presence of gall stones, (3) detection of pericholecystic fluid, (4) gallbladder wall thickness, (5) common bile duct (CBD) diameter, (6) the presence of a double wall sign, and (7) overall diagnostic impression as determined by the EMR based on history, physical exam, and the above factors.

All EMRs participated in a two-hour introduction to the operation of the Aloka SSD-1400 and RUQ US techniques prior to the study period and US examinations were performed using a 3.5 MHz curved linear array probe. Images were recorded with a Sony thermographic printer.

An RDMS EP-sonographer who completed a community college certification program subsequently reviewed US images and interpretations for resident feedback, but these comments were not used to alter the performance characteristics of the residents

The results of the EMR-performed RUQ scans were compared against operative findings when available, otherwise department of radiology evaluations were used as gold standards for the diagnosis of gallstones and cholecystitis. Statistical analysis was done using VassarStats. This study was approved by the IRB at our institution

## RESULTS

From April 2000 to February 2002, 148 patients were evaluated by 29 EMRs with RUQ US prior to gold standard evaluation (table 1).

**Figure 1**

Table 1: Gold standard evaluations

Gold Standard Evaluation	#
OR only	2
CT/US then OR	13
Cholangiogram	1
US	82
HIDA then US	1
CT	62

Overall, 66 of the 148 patients had gallstones on gold standard evaluations. EMR-performed RUQ US had a sensitivity and specificity for gallstones of 95.5% (95% CI (86.4-98.8%)) and 90.2% (95% CI (81.2-95.4%)) (table2). 14 patients had acute cholecystitis diagnosed by gold standard evaluations. EMR-performed RUQ US had a sensitivity and specificity for cholecystitis of 92.9% (95% CI (64.2-99.6%)) and 93.3% (95% CI (87.3-96.7%)) (table 2).

**Figure 2**

Table 2: sensitivity and specificity of EMR-performed RUQ US

	TP	TN	FP	FN	Sensitivity	Specificity
Gallstones	63	74	8	3	95.5% (86.4-98.8)	90.2% (81.2-95.4)
Acute cholecystitis	13	125	9	1	92.9% (64.2-99.6)	93.3% (87.3-96.7)

## DISCUSSION

This study found that EMRs could accurately perform RUQ US for the detection of gallstones and diagnosis of cholecystitis in selected patients. Our sensitivity and

specificity for gallstones were consistent with prior EM studies involving well-trained EPs (<sup>3,4,5,6</sup>, table 3) and even those in the radiology literature (<sup>8</sup>). That EPs can detect gallstones is important since 99% of patients with acute cholecystitis have gallstones (<sup>9</sup>).

**Figure 3**

Table 3: Studies in the emergency medicine literature relating to RUQ US. ((#) corresponds to reference numbers.)

STUDY	DESIGN	N	FOLLOW-UP	SENSITIVITY AND SPECIFICITY
Jehle, et al (3)	Retrospective chart review	46	Formal radiographic studies not obtained on all patients	Sensitivity/specificity not reported
Schlager, et al (4)	Prospective; convenience sample	85	Formal radiographic studies not obtained on all patients	Cholelithiasis: sens 86%, spec 97%
Rosen, et al (5)	Prospective; Convenience sample	116	Radiology Department Ultrasound and clinical follow-up	Cholelithiasis: sens 92%, spec 78% Cholecystitis: sens 91%, spec 86%
Kendall and Shrimp (6)	Prospective; Convenience sample	109	Radiology Department ultrasound	Cholelithiasis: sens 96%, spec 86%
Blavias, et al (7)	Retrospective chart Review	753	Formal radiographic studies not obtained on all patients	Sensitivity and specificity not reported; LOS reduced by 21% for "after hours" patients discharged home

One concern that has been raised is that EPs might miss evidence of cholecystitis, although they might be able to detect gallstones (<sup>10</sup>). In our population, only one patient with cholecystitis would have been missed by US findings alone. In that case, the operator correctly identified the presence of gallstones and normal wall thickness, but did not appreciate the presence of "mild" pericholecystic fluid identified by department of radiology RUQ US. However, the patient had an elevated WBC count and was admitted to the hospital for IV antibiotics and further management. Thus, no case of acute cholecystitis was missed in our sample.

This study is the first study evaluating EMR-performed RUQ US. Previous studies involved well-trained attendings or senior residents with limited numbers (<sup>3,4,5,6,7</sup>, table 3). In this study, however, the EMRs had limited didactic training (2 hours) and performed, on average, less than three prior US exams. Secondly, it is the only study in the EM literature evaluating a large number of residents outside of a specific research protocol (ie, not involving a few well-trained attending EPs) as almost 50% of the EM residents (29 of 60) performed RUQ US exams during the study period. Finally, it is the only study in the literature assessing the accuracy of EMR-performed RUQ US.

## LIMITATIONS AND FUTURE QUESTIONS

There were several limitations to this study. First, a convenience sample was used. While this does limit the study, it may be that those patients a particular resident feels comfortable evaluating with US —whether due to patient habitus or other factors—can be accurately assessed for gall

bladder pathology. If this is true, reserving more difficult patients (eg, morbidly obese patients) for immediate formal radiographic evaluation might allow for better utilization of resources in the ED. Secondly, as with all previous studies in the EM literature involving RUQ US, this was a single-center study. While a multi-center study would provide a better assessment of EMR ability to perform RUQ US, this would be difficult due to the varying levels of US utilization in different EDs and EM residencies. Third, although 29 of 60 residents performed exams during the study period, 13 of them accounted for 88 of the exams. This likely biased our study towards those EMRs interested in US. Finally, a consistent gold standard was not used. This, however, correlates with clinical practice as documented in the literature (<sup>2</sup>). Recent advances in CT helical technology have allowed for greater accuracy, proving in a number of cases to be more accurate than transabdominal RUQ US (<sup>2</sup>, <sup>11,12,13,14,15,16,17</sup>). Likewise, the gastroenterology literature using ERCP as the gold standard has also shown that helical CT can be more accurate than transabdominal RUQ US, especially in detecting common bile duct pathology (<sup>18, 19</sup>).

### CONCLUSION

Our data demonstrate that EMRs can accurately perform RUQ US for the diagnosis of gallstones and acute cholecystitis in selected patients, which has not been shown previously.

### CORRESPONDENCE TO

Timothy Jang, MD  
Division of Emergency Medicine  
Campus Box 8072  
St. Louis, MO 63110  
(314) 362-9177  
FAX (314) 362-0478

### ACKNOWLEDGMENTS

We acknowledge (1) Bill Hosek, MD, for his work in beginning the ultrasound education program for the Division of Emergency Medicine at Barnes-Jewish Hospital, St. Louis, MO, (2) Cora Sias, for her assistance in maintaining resident ultrasound portfolios, and (3) the faculty of the Division of Emergency Medicine and the Department of Surgery at Barnes-Jewish Hospital, St. Louis, MO, for their continued support of ultrasound education in emergency

medicine.

### References

1. Kalser SC. National Institutes of Health consensus development conference statement on gallstones and laparoscopic cholecystectomy. *Am J Surg* 1993;165:390-6.
2. Kalloo AN, Kantsevoy SV. Gallstones and biliary diseases. *Primary Care*. 2001; 28:591-606.
3. Jehle D, Davis E, Evans T, et al. Emergency department sonography by emergency physicians. *Am J Emer Med* 1989;7:605-11.
4. Schlager D, Lazzareschi G, Whitten D, et al. A prospective study of ultrasonography in the ED by emergency physicians. *Am J Emerg Med* 1994;12:185-9.
5. Rosen CL, Brown DF, Chang Y, et al. Ultrasonography by emergency physicians in patients with suspected cholecystitis. *Am J Emerg Med* 2001;19:32-6.
6. Kendall JL and Shimp RJ. Performance and interpretation of focused right upper quadrant ultrasound by emergency physicians. *JEM* 2001;21:7-13.
7. Blavias M, Harwood RA, Lambert MJ. Decreasing length of stay with emergency ultrasound examination of the gallbladder. *Acad Emerg Med* 1999;6:1020-3.
8. Hessler PC, Hill DS, Detorie FM, et al. High accuracy of sonographic recognition of gallstones. *AJR* 1981;136:517-20.
9. Ralls PW, Colletti PM, Lapin SA, et al. Real-time sonography in suspected acute cholecystitis: a prospective evaluation of primary and secondary signs. *Radiology* 1985;155:767-71.
10. Durston W, Carl ML, Guerra W, et al. Comparison of quality and cost-effectiveness in the evaluation of symptomatic cholelithiasis with different approaches to ultrasound availability in the ED. *Am J Emerg Med* 2001; 19:260-269.
11. Pasanen P, Partanen K, Pikkarainen P, et al. Ultrasonography, CT, and ERCP in the diagnosis of choledochal stones. *Acta Rad* 1992; 33:53-56.
12. Neitlich JD, Topazian M, Smith RC, et al. Detection of choledocholithiasis: comparison of unenhanced helical CT and endoscopic retrograde cholangiopancreatography. *Radiology* 1997; 203:753-757.
13. Fidler J, Paulson EK, Layfield L. CT evaluation of acute cholecystitis: findings and usefulness in diagnosis. *AJR* 1996; 166:1085-8.
14. Paulson EK. Acute cholecystitis: CT findings. *Seminars in Ultrasound, CT, & MR*. 2000; 21:56-63.
15. Van Hoe L. Imaging prior to laparoscopic cholecystectomy: transabdominal US, CT, and MRI. *Acta Gastro Belg* 2000; 63:293-4.
16. Dodd GD, Niedzwiecki GA, Campbell WL, et al. Bile duct calculi in patients with primary sclerosing cholangitis. *Radiology* 1997; 203:443-447.
17. Soto JA, Velez SM, Guzman J. Choledocholithiasis: diagnosis with oral-contrast-enhanced CT cholangiography. *AJR* 1999; 172:943-948.
18. Sugiyama M, Atomi Y. Endoscopic ultrasonography for diagnosing choledocholithiasis: a prospective comparative study with ultrasonography and computed tomography. *Gastrointest Endosc* 1997; 45:143-146.
19. Amouyal P, Amouyal G, Levy P, et al. Diagnosis of choledocholithiasis by endoscopic ultrasonography. *Gastroenterology* 1994; 106:1062-1067.

**Author Information**

**Timothy Jang, MD**

Division of Emergency Medicine, Washington University School of Medicine

**Chandra Aubin, MD**

Division of Emergency Medicine, Washington University School of Medicine

**Rosanne Naunheim, MD**

Division of Emergency Medicine, Washington University School of Medicine