The correlation between ultrasonography and histology in the search for gallstones

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ABSTRACT

INTRODUCTION The majority of published data on the sensitivity and specificity of ultrasound in the diagnosis of gallbladder pathology was conducted over 30 years ago and, since the 1990s, ultrasound imaging has been the accepted gold standard. The quality and resolution of ultrasonography has improved significantly since then and we have, therefore, set out to assess whether the progression in technology has translated into improved diagnostic accuracy.

PATIENTS AND METHODS In the period December 2005 to December 2008, a total of 2100 patients underwent laparoscopic cholecystectomy for symptoms related to gallbladder disease. All patients underwent ultrasound examination prior to their surgery and histopathological analysis of their gallbladder postoperatively. We undertook a retrospective analysis of these patients comparing their pre-operative ultrasound scan and their histopathology report for the presence or absence of gallstones. Ultrasound scans were performed by a combination of radiologists and ultrasonographers.

RESULTS The study identified a sensitivity of 0.85 and a specificity of 1 for ultrasound in the identification of gallstones. We found a sensitivity of 0.84 and 0.83 for the radiologists and ultrasonographers, respectively.

CONCLUSIONS This study suggests that, despite an evolution in the resolution of ultrasound imaging, there has not been a corresponding improvement in sensitivity. There is a false positive rate of 16% which remains unchanged since the early 1990s.

KEYWORDS

Gallstones – Radiology – Ultrasonography – Histopathology – Diagnostic accuracy

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In the US, 10–20% of the adult population has gallstones. Whilst the majority of individuals with gallstones remain asymptomatic, 2–5% of the 20 million individuals with gallstones experience symptoms each year.¹ The majority of the 500,000–750,000 cholecystectomies performed annually in the US are for biliary pain or cholecystitis, making it the most common abdominal surgical operation in the US.² Due to the fact that the symptoms of gallstones are varied and may resemble other disorders, it is important to have tools that accurately confirm or exclude suspected gallstone disease. Ultrasonography plays a major role in the detection of suspected gallbladder disease. Ever since the first pulse-echo method proved to be a successful diagnostic tool in 1947, ultrasound has steadily and increasingly been applied. Real-time ultrasound has made it possible to perform dynamic examinations, and an improved and accurate search for gallstones has resulted.³ The majority of work upon the efficacy of ultrasound in its assessment of gallbladder pathology was conducted 30 years ago when ultrasound began to take over as the primary modality in its diagnosis. It became the accepted gold standard in the early 1990s when meta-analyses demonstrated its superior sensitivity over computerised tomography (CT) and oral

cholecystography.⁵ Since then, the quality and resolution of ultrasonography⁴ has improved significantly; therefore, we set out to assess whether this progression in technology had translated into an improved ultrasound sensitivity and specificity for the diagnosis of gallstones.

Patients and Methods

In the period December 2005 to December 2008, a total of 2100 patients, underwent laparoscopic cholecystectomy for symptoms related to gallstone disease. All patients underwent ultrasound examination prior to their surgery and histopathological analysis of their gallbladder postoperatively. We undertook a retrospective analysis of these patients comparing their pre-operative ultrasound scan and their histopathology report for the presence or absence of gallstones. Overall, 231 patients were excluded due to the presence of open gallbladder specimens sent to histology leaving 1869 patients in the study cohort. Ultrasound scans were performed by a combination of radiologists and ultrasonographers throughout the trust. Histopathology specimens were reported by a range of consultant and specialist

registrar pathologists. All data were accessible via the PACS Radiology programme and REVIEW Pathology programme on the Trust Intranet. No ethical permission was requested for this study.

Results

A total of 1869 ultrasound scans were performed of which 1823 were positive for gallstones and 46 negative for gallstones. Of the positive group, 1549 were confirmed to have gallstones on histopathology, whilst 274 were found to have no gallstones on histopathology. Of the 46 ultrasound scans found to be negative for gallstones, there were no cases of subsequent gallstones being found on histopathology with all histopathological specimens being absent of gallstones. This provided a positive predictive value (PPV) of 0.85 and a negative predictive value (NPV) of 1 (Fig. 1).

A total of 649 ultrasound scans were performed by radiologists. Of these, 633 were positive for gallstones and 16 negative for gallstones. Of the positive group, there were

534 cases of gallstones confirmed on histopathology and 99 cases of no gallstones found on histopathology. In the negative for gallstones ultrasound group, there were no cases of subsequent gallstones being found on histopathology with all specimens being absent of gallstones. This provided a PPV of 0.84 and NPV of 1 for the radiologists (Fig. 2).

A total of 1220 ultrasounds were performed by ultrasonographers. Of these, 1191 were positive for gallstones and 29 negative for gallstones. Of the positive group, there were 986 cases of gallstones confirmed on histopathology and 205 cases of no gallstones found on histopathology. In the negative for gallstones ultrasound group, there were no cases of subsequent gallstones being found on histopathology with all specimens being absent of gallstones. This provided a PPV of 0.83 and NPV of 1 for the ultrasonographers (Fig. 3).

Discussion

Ultrasound scanning has been the modality of choice for the clinical diagnosis of gallstone disease for the last 25 years. It is

accepted to possess a higher sensitivity than oral cholecystography or computed tomography.⁵ Ultrasound technology has undergone a period of maturation. Competition between ultrasound manufacturers and developments in computing have resulted in a significant improvement in image resolution. With such progress in technology, one would assume that the sensitivity of the diagnostic tool would also increase.⁴ Meta-analysis of studies between 1966–1992 assessing the diagnosis of biliary disease produced figures of the adjusted sensitivity of ultrasound for the diagnosis of gallstones at 0.84 and a specificity of 0.99.⁵ These figures are similar to the figures that we collected nearly 20 years later. The question, therefore, remains as to why it is that, with an increase in ultrasound resolution, there has been no corresponding improvement in sensitivity? Gallstones in the neck of the gallbladder are always difficult to identify due to the area surrounding the neck of the gallbladder being echogenic itself and as the stones cannot move.⁶ There is the possibility that stones may be lost during cholecystectomy which accounts for findings. The incidence of spillage of stones is difficult to quantify but varies from figures as low as 3.3% to 17% and non-retrieval of 0.3%.⁷ The spillage is most likely to occur during perforation of the gallbladder and is believed to occur in between 8–32% of laparoscopic cholecystectomies.⁸ However, we excluded all open specimens excluding the possibility of spillage from our study.

A factor known to limit the accuracy of ultrasonography is body habitus. Studies have suggested a linear increase in habitus limited reports as a result of increasing obesity.⁹ With the development of an increasingly obese population, there is a possibility that this may be negating the improvements in ultrasound resolution over the same time period. We did not address this in our study, but it is an area which deserves further investigation.

It is a wide-spread held belief that the performance and interpretation of ultrasonography by a qualified radiologist is more accurate than that performed by an ultrasonographer. However, our study does not support this with a PPV of 0.84

and 0.83 for radiologists and ultrasonographers, respectively. This has implications for the funding of ultrasonography services as there is no evidence that a well-trained ultrasonographer's report should be inferior to that of a radiologist.

The question arises as to whether we are happy in the 21st century to accept working with a modality that has a sensitivity of 84% or do we wish to progress to something else. Magnetic resonance cholangiopancreatography has been widely accepted for its sensitivity in the diagnosis of choledocholithiasis but has never been proven superior to ultrasound in cholelithiasis.¹⁰ With an increasingly obese population, particular attention may well be warranted to this subgroup and CT cholecystography has shown promising results in small trials but would require further exploration.¹¹

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