The positive predictive value of diagnostic ultrasound for occult herniae

M BRADLEY¹, J MORGAN², B PENTLOW², A ROE²

Departments of ¹Radiology and ²Surgery, North Bristol Trust, Southmead Hospital, Westbury on Trym, Bristol, UK

ABSTRACT

INTRODUCTION The aim of this study is to ascertain the accuracy of diagnostic ultrasound in the assessment of the occult abdominal and groin herniae. The authors have previously demonstrated its efficacy in diagnosing the type of clinical groin herniae but occult herniae provide a further diagnostic problem.

PATIENTS AND METHODS A total of 113 consecutive patients were referred prospectively for ultrasound examinations with clinically suspected occult herniae. All positive scans were offered surgery whilst the negative results were offered further imaging or other diagnostic tests depending on the clinical criteria. The end point for negative scans was based on 18-month follow-up or resolution of symptoms.

RESULTS Overall, 59 scans showed positive results for herniae and 56 of these had surgery. In the other three patients, two refused an operation, and one had no hernia detected at operation. In the remaining 57 scans, ultrasound offered alternative soft tissue diagnoses in 23 patients and surgical/endoscopic diagnoses accounted for a further 8 patients.

CONCLUSIONS Ultrasound offered a diagnosis for the symptomology in 82 patients (70.6%) of which 59 were herniae. The positive predictive value for hernia is 98.3%. Twenty-six patients with no diagnosis or confirmation of herniae on follow-up showed symptom resolution in 22 cases, and four patients were treated by the pain clinic.

KEYWORDS

Ultrasonography – Occult hernia

CORRESPONDENCE TO

Dr Mike Bradley, Department of Radiology, North Bristol Trust, Southmead Hospital, Westbury on Trym, Bristol BS10 5NB, UK
T: +44 (0)117 959 5524; F: +44 (0)117 959 5122; E: mike.bradley@north-bristol.swest.nhs.uk

Occult herniae are by definition difficult to diagnose as there may be insubstantial corroborative findings on examination and the history may be insufficiently specific preventing the surgeon from advocating an operation without further investigation. Previously, the radiological examination has relied on herniography to provide the diagnosis.¹ Ultrasound now offers very accurate dynamic soft tissue imaging which is largely unrivalled by other cross-sectional imaging modalities. This study aims to identify whether ultrasound can be accurate for the diagnosis of hernia and so compete with traditional imaging for the occult hernia diagnosis.

Patients and Methods

A total of 113 patients were referred prospectively for an ultrasound examination with a clinical suspicion of occult hernia, and this was undertaken by an experienced

radiologist. There were a total of 116 examinations with 3 patients having bilateral symptoms.

The patients were seen by an experienced surgical consultant. Clinical diagnoses of occult herniae were based on history and examination. Patients invariably complained of localised pain but the signs and symptoms were variably present and not reproducible. The clinical examination was usually negative for cough impulse or lump. Many of the patients were overweight making the clinical examination difficult, hence diagnostic imaging was requested.

Patients with a positive ultrasound for hernia were offered surgery. In only one patient was it felt clinically justified to proceed to surgery with a negative ultrasound. Some of the remaining patients had alternative soft tissue diagnoses on ultrasound or other imaging including CT and MRI. Some had diagnoses based on evolving clinical criteria and some with endoscopy. The ultrasound examination was conducted using an ATL 5000 with an 8–12 MHz linear

Figure 1 Ultrasound demonstration of a epigastric hernia containing omentum (short arrows). Long arrows, peritoneum; L, liver; B, bowel.

probe. The scan was performed supine and erect as well as dynamically using coughing and valsalva manoeuvres. The patients were asked to raise their head off the bed to contract the recti muscles. Ultrasound features of hernia included direct visualisation of a hernia sac containing bowel or omentum; a positive cough/valsalva impulse which was reducible. The majority of patients' symptoms were related to the groin, but the remainder were possible Spigelian (Fig. 1), epigastric, incisional, para-umbilical, umbilical or lumbar herniae.

Results

Overall, 113 consecutive patients underwent 116 scans (three had bilateral groin symptoms). The age range was 21–94 years' old (mean, 57 years). The majority had groin symptoms (92), with 10 incisional and 14 with clinical suggestion of Spigelian, lumbar, epigastric, umbilical or para-umbilical herniae.

In the cohort, 59 (51%) patients had positive ultrasound scans for herniae and 56 had positive corroborative surgery.

Two refused an operation, and one patient had no surgical hernia (*i.e.* one false positive ultrasound result). This was in an obese patient which caused loss of sound penetration and difficulty with interpreting the valsalva manoeuvre. Of the scans, 57 (49%) were negative for hernia. Only one of these underwent a surgical procedure on clinical grounds but this proved negative for a hernia.

Surgically proven herniae included: 39 inguinal, 5 femoral, 8 incisional, 4 Spigelian, and 3 epigastric/para-umbilical.

The remaining 26 patients were followed up for up to 18 months; in 22, the symptoms completely resolved and four were treated successfully at the pain clinic.

Discussion

This study was designed to evaluate the role of ultrasound in the diagnosis of the occult hernia. It was not ethically possible to operate surgically on those patients with a negative scan except in one case where there appeared to be strong clinical justification. This means that it is not

possible to quote true sensitivity and specificities but ultrasound did only demonstrate one false positive result. The authors, however, in a previous study have demonstrated 100% sensitivity and specificity for hernia diagnosis in the pre-operative assessment of groin herniae.²

A study performed in children using ultrasound for occult groin herniae claimed 97.9% accuracy with the clinical diagnosis achieving 84% accuracy.⁵ Similarly, in adults, ultrasound was shown to have an accuracy of 92% for groin herniae compared to surgical findings.⁴ Ultrasound reports have not only claimed an accurate diagnosis of incarcerated versus non-incarcerated herniae,⁵ but have also used ultrasound to aid reduction of an incarcerated Spigelian hernia.⁶

In those patients who had no other alternative diagnosis confirmed on other imaging/criteria, only four had continued symptomatology after a period of follow-up of 18 months. These patients, however, failed to show any further clinical evidence of a hernia and so the authors suggest, in combination with their previous study results,² that the ultrasound scan reflects a high degree of accuracy. In this study, ultrasound shows a positive predictive value for hernia of 98.3%, and the authors expect the negative predictive value to be in a similar range. The use of this follow-up for the negative scans is substantiated by Eames *et al.*⁷ in their prospective study using herniography as their imaging modality: they did not demonstrate any developing hernia in 34 patients after a negative herniogram with a 3-year follow-up.

Other cross-sectional imaging modalities have claimed good results but are more expensive and less available. Herniography has been the well-tested radiological tool claiming up to 94% sensitivity and 95% specificity⁸ and success rates of 90.5%.⁹ However, herniography is invasive with reports of up to 5% major complication rates.¹⁰ The success of ultrasound relies on its excellent soft tissue spatial resolution and in its ability to be a true real-time and dynamic examination which is not possible with other cross-sectional imaging. This simple ultrasound method is easily taught and thus should be reproducible. Loftus *et al.*¹⁰ have reported false positives and false negatives of 18% and 7.9%, respectively, for herniography suggesting that even this test is not always reproducible.

In this study, the groin herniae appeared to give the surgeon the most difficult diagnostic dilemma. The other type of

herniae most often matched a positive ultrasound with the clinically suspected lesion. This probably relates to the difficult anatomy, the reproducibility of the cough impulse and patient body habitus.

MRI has been shown to demonstrate herniae but it has not shown great accuracy; where it does benefit is in the diagnosis of other musculoskeletal conditions which may give rise to pain (*e.g.* osteitis pubis).¹¹ However, ultrasound can diagnose many types of soft tissue injuries but MRI can also visualise conditions giving rise to marrow oedema. CT also gives mixed results for hernia diagnosis. Laparoscopy is a further tool in diagnosing occult herniae as well as the occult contralateral hernia, but this again is invasive.

References

1. Sutcliffe JR, Taylor OM, Ambrose NS, Chapman AH. The use, value and safety of herniography. *Clin Radiol* 1999; **54**: 468–72.
2. Bradley M, Morgan D, Pentlow B, Roe A. The groin hernia – an ultrasound diagnosis? *Ann R Coll Surg Engl* 2003; **85**: 178–80.
3. Chen KC, Chu CC, Chou TY, Wu CJ. Ultrasonography for inguinal hernias in boys. *J Pediatr Surg* 1998; **34**: 1890–1.
4. Lilly MC, Arregui ME. Ultrasound of the inguinal floor for evaluation of hernias. *Surg Endosc* 2002; **16**: 659–62.
5. Rettenbacher T, Hollerweger A, Macheiner P, Gritzmann N, Gotwald Frass R, Schneider B. Abdominal wall hernias: cross-sectional imaging signs of incarceration determined with sonography. *AJR Am J Roentgenol* 2001; **177**: 1061–6.
6. Torzilli G, Del Fabbro D, Felisi R, Leoni P, Gnocchi P, Lumachi V *et al.* Ultrasound guided reduction of an incarcerated Spigelian hernia. *Ultrasound Med Biol* 2001; **27**: 1133–5.
7. Eames NW, Deans GT, Lawson JT, Irwin ST. Herniography for occult hernia and groin pain. *Br J Surg* 1994; **81**: 1529–30.
8. Brierly RD, Hale PC, Bishop NL. Is herniography an effective and safe investigation? *J R Coll Surg Edinb* 1999; **44**: 374–7.
9. Gwanmesia II, Walsh S, Bury R, Bowyer K, Walker S. Unexplained groin pain: safety and reliability of herniography for the diagnosis of occult hernias. *Postgrad Med J* 2001; **77**: 250–1.
10. Loftus IM, Ubhi SS, Rodgers PM, Watkin DF. A negative herniogram does not exclude the presence of a hernia. *Ann R Coll Surg Engl* 1997; **79**: 372–5.
11. Barile A, Erriguez D, Cacchio A, De Paulis F, Cesare E, Masciocci C. Groin pain in athletes: role of magnetic resonance. *Radiol Med (Torino)* 2000; **100**: 216–22.