ORIGINAL ARTICLE

Are we overusing ultrasound in non-traumatic acute abdominal pain?

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Background: Ultrasound is being used increasingly in the assessment of acute non-traumatic abdominal pain as it is non-invasive and does not carry the risk of radiation. However, the inappropriate use of ultrasound can lead to a delayed or incorrect diagnosis, more work for the personnel involved, and increased hospital costs.

Methods: A prospective study was conducted to analyse the clinical indications for requesting an ultrasound in those admitted to a district general hospital with acute non-traumatic abdominal pain, and to assess whether there is a correlation between clinical and laboratory findings and ultrasound results. A total of 110 patients were studied during a three month period.

Results: The results suggest that ultrasound is useful in the investigation of suspected biliary colic and abdominal masses. However, the yield of ultrasound in other patients with acute non-traumatic abdominal pain is low. This study also suggests that the yield of "positive" reports on ultrasound is significantly higher in patients with localised abdominal pain and tenderness and in those with acute abdominal pain and a raised white cell count or raised liver function tests. The yield of positive reports in patients with acute abdominal pain was found to be lower those less than 25 years of age than in older patients.

Ultrasound has revolutionised the diagnosis of many intra-abdominal conditions. In patients with non-traumatic acute abdominal pain it is especially valuable in diagnosing hepatobiliary pathology and gynaecological conditions. However, its value in other scenarios, such as suspected acute appendicitis, remains controversial.^{1,2} Inappropriate use of ultrasound in the assessment of acute abdominal pain can lead to an increase in the workload of the personnel involved, prolonged inpatient stay, possible delay in treatment, and increased hospital costs.

The aims of this study were, first, to analyse the clinical indications for requesting an abdominal ultrasound in patients admitted to a district general hospital with acute abdominal pain and to assess the yield of "positive" reports with respect to the various clinical indication groups, and, second, to identify factors, both demographic and clinical, that may be associated with a high positive yield of ultrasound examinations performed for acute abdominal pain.

METHODS

We performed a prospective analysis of all patients who underwent an ultrasound for non-traumatic acute abdominal pain by two ultrasonographers in a district general hospital over a three month period from June 2001 to August 2001. The equipment used was an ATL HDI 5000 scanner (Advanced Technology Laboratories, Bothell, WA, USA) with a broadband curved array transducer. Data were recorded on demographics, clinical symptoms and signs before the procedure, the suspected clinical diagnosis, laboratory results, and the ultrasound findings. A report was considered to be "positive" if it correlated with the patient's clinical picture and aided in the management of the patient's condition. Statistical analysis was performed using the χ^2 test, and $p < 0.05$ was considered to be significant.

RESULTS

A total of 110 patients underwent an abdominal ultrasound for acute abdominal pain during the study period, of which

61 were females. The mean age of the patients was 44 years. Of the 110 patients, 49 scans (45%) were found to be positive. The other results are presented in tables 1 and 2.

DISCUSSION

Diagnosis of many acute abdominal conditions relies on a good history and physical examination supplemented by relevant laboratory tests and the appropriate use of radiological investigations.^{3,4} There is no single radiological test that is uniformly effective in identifying the cause of acute abdominal pain. Various factors, including age, sex, habitus, and the suspected clinical diagnosis, determine the choice of radiological investigation.⁵

Owing to the risks posed by the radiation associated with tests such as computed tomography and scintigraphy, ultrasound has grown in popularity as an easy and quick way of imaging the abdomen. This has led to a considerable increase in the number of such scans being performed for acute abdominal pain, some of which may be inappropriate. The routine use of ultrasound examination in acute abdominal pain may lead to earlier diagnosis of some conditions but has not been found to be associated with a shorter duration of inpatient care.⁶ However, the routine use of ultrasound in "the acute abdomen" has both clinical and economic consequences. False reporting can lead to inappropriate or delayed treatment. In the long term, hospital costs can increase owing to the increased workload of the personnel involved and prolonged inpatient stays. Some studies have suggested that surgeons should be trained to perform ultrasound scans on their own patients with "an acute abdomen" to reduce the waiting time, thereby saving costs.⁷

The aim of our study was to analyse the clinical indications for requesting an abdominal ultrasound in patients admitted to our hospital with non-traumatic acute abdominal pain.

Abbreviations: LFT, liver function test; WCC, white cell count

Table 1 Clinical indications for requesting an ultrasound, and results

Clinical indication	No of patients	No (%) of positive scans
Biliary pathology	31	25 (81)
Acute pancreatitis	10	6 (60)
Non-specific abdominal pain	16	1 (6)
Possible appendicitis	14	4 (29)
Possible pelvic inflammatory disease	2	0
Abdominal or pelvic mass	6	6 (100)
Possible gastritis	7	0
Possible intra-abdominal malignancy	2	1 (50)
Renal colic	13	2 (15)
Acute diverticulitis	6	4 (67)
Possible musculoskeletal pain	3	0

The age and sex of the patient, clinical symptoms and signs,⁸ and laboratory results are all important in making a clinical diagnosis. An attempt was also made to determine whether there is a correlation between these factors and the results of abdominal ultrasound examination.

The most common reason for requesting an ultrasound was suspected biliary pathology. As expected, the yield was high (81%), and all the positive scans confirmed the initial clinical diagnosis.

Of the 10 patients with acute pancreatitis (all patients had serum amylase exceeding 1000 IU), the pancreas was imaged in only two of them (20%), showing evidence of pancreatic oedema or peripancreatic fluid collection.⁹ The pancreas was obscured by bowel gas in the remaining patients. However, stones in the gall bladder were detected in six of the 10 patients, thereby aiding patient management. These have therefore been included in the "positive scans" group.

Patients diagnosed as having non-specific abdominal pain on the basis of a lack of specific clinical signs formed the second largest group to undergo an ultrasound examination. Only one of the 16 patients (6%) had findings that were considered abnormal and that could have been the cause of the patient's symptoms.

All patients with a clinically palpable mass had the diagnosis confirmed by the ultrasound, which was helpful in determining the nature of the abdominal mass.

The yield was also high in patients with suspected acute diverticulitis.¹⁰ Four of the six patients with this clinical diagnosis had ultrasound evidence of thickening and oedema of the sigmoid colon.

The yield was, however, relatively lower in patients with suspected appendicitis (29%). Of the four patients with positive findings, three were subsequently found to have an appendicular mass that was not clinically detected preoperatively. Six of the 10 patients with negative scans later underwent surgery for appendicitis. An ultrasound scan was not requested for suspected appendicitis if the patient had a combination of a reliable history of right iliac fossa pain along with localised tenderness and a raised white cell count (WCC) or raised C-reactive protein.

Ten patients underwent a scan after a clinical diagnosis of suspected gastritis or musculoskeletal pain. No abnormality was detected in any of these patients.

Of the 13 patients with suspected renal colic who had an ultrasound scan, only two had positive findings.

There was no significant difference in the yield of abdominal ultrasound between male and female patients with acute abdominal pain (43% v 39%). Of the 27 patients younger than 25 years of age, five (19%) had a positive finding on ultrasound, as against 40 out of 83 patients (48%)

Table 2 Clinical factors and ultrasound results

	No of patients	No (%) of positive scans
Demographic factors		
Males	49	21 (43)
Females	61	24 (39)
Patients aged less than 25 years	27	5 (19)
Patients aged more than 25 years	83	40 (48)
Clinical symptoms		
Diffuse pain	44	9 (20)
Localised pain	66	36 (55)
Diffuse tenderness	42	11 (26)
Localised tenderness	68	34 (50)
Pain + raised WCC or abnormal LFTs	65	36 (55)
Pain + normal WCC and LFTs	45	9 (20)
Localised tenderness + raised WCC or abnormal LFTs	40	27 (68)
Localised tenderness + normal WCC and LFTs	28	7 (25)
Diffuse tenderness + raised WCC or abnormal LFTs	25	9 (36)
Diffuse tenderness + normal WCC and LFTs	17	2 (12)

WCC, white cell count; LFT, liver function test.

older than 25 years. This was statistically significant ($p < 0.01$) and may be due to a difference in the nature of the pathology encountered between the two groups. A large number of patients younger than 25 years were admitted with features suggestive of non-specific abdominal pain, appendicitis, or gastritis, while biliary colic and diverticulitis were more common in those older than 25 years.

The patients were divided into two groups based on the site of the abdominal pain. Pain involving three or more anatomical quadrants of the abdomen and crossing the midline was classified as diffuse pain, and any other pain was classified as localised pain. While only nine of the 44 patients with diffuse pain (20%) had positive findings on ultrasound, 36 out of 66 patients with localised pain (55%) had positive findings. This was found to be statistically significant on applying the χ^2 test ($p < 0.001$). By common observation, diffuse pain commonly arises from the bowel or retroperitoneal structures. Ultrasound is less useful in imaging the bowel than the solid organs, and may also be unhelpful in many cases of acute pain arising from the retroperitoneal structures, when invariably there is some degree of associated ileus. This is probably reflected in our results. However, we acknowledge that recent advances in ultrasound technology have improved the quality of bowel imaging considerably.

A larger percentage of patients with diffuse tenderness than diffuse pain had positive findings on ultrasound (26% v 20%). This could be because tenderness may be an indication of irritation of the parietal peritoneum due to the underlying pathology, which is more superficial and, hence, more amenable to ultrasound detection. Localised tenderness was more likely to be associated with a positive scan (50%) than was diffuse tenderness ($p < 0.02$).

Laboratory tests, such as full blood count, urea and electrolytes, and liver function tests (LFTs), are routinely performed in patients with acute abdominal pain. The correlation between the results of these tests and the results of an abdominal ultrasound was analysed. In total, 65 patients with abdominal pain had either a raised WCC or abnormal LFTs or both; 36 of these patients (55%) had positive findings on abdominal ultrasound. Of the 45 patients with abdominal pain and normal blood results, only nine had a positive scan (20%); six of these patients were found to have gall stones, two patients had intra-abdominal masses that were clinically palpable, and one patient with a clinical

Learning points

- Abdominal ultrasound is a useful investigation in the assessment of suspected acute biliary colic, acute colonic diverticulitis, and abdominal masses.
- The yield of ultrasound is lower in younger patients (those less than 25 years old) with acute non-traumatic abdominal pain.
- Patients with localised abdominal pain and tenderness are more likely to have a positive diagnosis on ultrasound.
- Raised WCC or an abnormal LFT in patients with acute abdominal pain is predictive of a higher yield of positive reports on ultrasound examination.

diagnosis of non-specific abdominal pain had an ovarian cyst and a small amount of free fluid in the pelvis.

We acknowledge that an ultrasound scan reported as normal is also valuable in the management of some patients. We do not suggest that ultrasound should be restricted to those with localised symptoms and signs and to those with abnormal blood results. The clinical diagnosis of a patient's condition and the request for further radiological investigations must be based on a combination of demographic factors, clinical symptoms and signs, and laboratory results, and not just on individual factors. However, if there are concerns about an individual patient in spite of non-specific signs and normal blood results then an ultrasound scan may help to determine whether to proceed to further invasive procedures, such as laparoscopy or laparotomy, or to continue observation.

In our study, 27 out of 40 patients with a combination of localised tenderness and raised WCC or abnormal LFTs had positive scans (68%), compared with two out of 17 patients with diffuse tenderness and normal blood results (12%) ($p < 0.001$). This difference is quite marked. This study also re-emphasises the value of ultrasound in suspected biliary pathology, evaluation of abdominal masses, and, possibly, acute diverticulitis. For the other clinical indications a selective approach based on the assessment of a combination of clinical symptoms and signs and laboratory tests is recommended. This may help to reduce the number of

unnecessary scans, thereby improving the efficiency of the service and reducing the costs.

CONCLUSIONS

Abdominal ultrasound is a valuable investigation in patients with suspected biliary pathology and in evaluating abdominal masses. Patients with localised abdominal pain and tenderness are more likely to have a positive finding on ultrasound examination than are those with diffuse abdominal pain and tenderness. A positive diagnosis on ultrasound is more likely in patients with a combination of abdominal pain and raised WCC or abnormal LFTs. Ultrasound is less useful in patients who are less than 25 years of age, especially when the symptoms and signs are non-specific and the laboratory results are normal.

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