Factors predicting significant pathology on ultrasonography in women presenting with non-specific lower abdominal pain

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ABSTRACT

INTRODUCTION Ultrasonography is used frequently to exclude significant pathology in young women presenting with non-specific lower abdominal pain (NSLAP). This study examined parameters that predicted the likelihood of significant findings on ultrasonography. These results could be used to select patients for priority imaging or identify those who could be managed with no ultrasonography.

METHODS A total of 65 women with NSLAP were identified from 283 admissions. Group 1 ($n=42$) consisted of patients with normal imaging. Group 2 ($n=23$) included patients with 'positive' scans requiring treatment. White cell count (WCC), C-reactive protein (CRP) levels, platelet count, age, duration of pain and length of stay in hospital were compared between the groups.

RESULTS The median WCC and CRP were greater in Group 2 than in Group 1: $15 \times 10^9/l$ and 123mg/l versus $11 \times 10^9/l$ and 72mg/l respectively ($p=0.01$ and $p=0.05$). CRP was a weak predictor of positive pathology on ultrasonography (area under curve [AUC]=0.66, $p=0.027$) and WCC was a strong predictor of abnormal pathology on ultrasonography (AUC=0.7, $p=0.005$). A WCC of $>12.8 \times 10^9/l$ was 65% sensitive and 71% specific in predicting subsequent pathology on ultrasonography. The median wait for ultrasonography was 24 hours (range: 1–96 hours).

CONCLUSIONS This study failed to define any criteria that could select patients not requiring ultrasonography. Since ultrasonography is a relatively cheap and safe investigation, its continued use to screen women with NSLAP is justified. WCC should be used to prioritise imaging.

KEYWORDS

Ultrasonography – Pathology – Abdominal pain

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Abdominal pain is one of the most common causes (5–10%) for admission to the emergency department.¹ The aetiology is variable, ranging from benign conditions to surgical emergencies requiring immediate attention. It has been reported that, of all patients presenting with acute abdominal pain, 35–44% have non-specific lower abdominal pain (NSLAP).^{2,3} This subgroup of patients can be challenging if history taking, examination and baseline blood tests do not suggest an immediate diagnosis. This is particularly difficult in women as the differentiation of pelvic from abdominal pathology is problematic. Therefore, ultrasonography is employed frequently to exclude pathology in young women with NSLAP. However, performing ultrasonography for every patient with NSLAP imposes a significant financial and workforce burden. To improve the efficiency of the system, it is important to use resources appropriately.

This study examined parameters that predicted the likelihood of significant pathology on ultrasonography. The

results could be used to select patients for priority imaging or to identify those who do not require ultrasonography and can be managed expectantly.

Methods

A retrospective observational study was performed. All women admitted with lower abdominal pain were detected from coding records from 1 January to 31 December 2010. A total of 283 patient notes were examined in this study period. Patients with NSLAP who had undergone ultrasonography (as their primary modality of imaging on admission) were identified. NSLAP was defined as lower abdominal pain lasting for more than 1 day and fewer than 45 days with an undefined diagnosis after history, clinical examination and baseline blood tests. Exclusion criteria included patients with gallbladder disease and those who had a laparoscopy/laparotomy for an acute abdomen without ultrasonography.

Data were extracted from patient notes, including age, duration of pain, length of stay in hospital, white cell count (WCC), C-reactive protein (CRP) levels and platelet count. A total of 65 patients were included in the final analysis.

Patients were categorised into two groups: Group 1 ($n=42$) included patients with normal ultrasonography and Group 2 ($n=23$) those with positive imaging. Imaging was considered positive if the findings correlated with the patient's clinical findings and influenced the management. Normal ultrasonography was defined as imaging demonstrating no abnormal pathology or imaging in which abnormal findings (such as non-degenerative fibroids) were found but were not consistent with the cause of the patient's pain.

The main aim of the study was to define indications for ultrasonography in women with lower abdominal pain. A further objective was to investigate whether there were any parameters that could be used to prioritise patients for ultrasonography. Student's t-test was used to compare the

groups and a receiver operating characteristic (ROC) curve with area under the curve values (AUC) was used to assess the predictive value of serological parameters, systemic inflammatory response, duration of pain, total length of stay and wait for a scan in predicting positive ultrasonography. A p -value of <0.05 indicated a statistically significant difference. All calculations were performed with MedCalc® version 11.6.1 (MedCalc Software, Mariakerke, Belgium).

Results

Sixty-five women who fulfilled the inclusion criteria were identified. WCC, CRP levels, platelet count, age, duration of pain and length of stay in hospital were compared between the two groups (Table 1). The median WCC was significantly ($p=0.01$) higher in Group 2 ($15 \times 10^9/l$) than in Group 1 ($11 \times 10^9/l$). Similarly, CRP was higher in Group 2 (123mg/l) than in Group 1 (72mg/l) although this difference was not statistically significant ($p=0.05$).

Table 1 Subject demographics and selected clinical data

	Group 1 ($n=42$) Median (range)	Group 2 ($n=23$) Median (range)	p -value Median (range)
Age (years)	32 (17–83)	30 (17–88)	0.45
Duration of pain (days)	2 (1–21)	7 (1–42)	1.00
Platelet count ($\times 10^9/l$)	275 (175–536)	308 (153–844)	0.15
White cell count ($\times 10^9/l$)	11 (5–24)	15 (5–41)	0.01
C-reactive protein (mg/l)	72 (5–375)	123 (5–387)	0.05
Total length of stay (days)	3 (0–20)	5 (1–30)	0.13
Wait for scan (days)	1 (0–4)	1 (0–2)	

Table 2 Predictive value of white cell count

WCC	Sensitivity	95% CI for sensitivity	Specificity	95% CI for specificity	+PV	-PV	+LR
$>4.9 \times 10^9/l$	100%	85.2–100%	2.38%	0.06–12.6%	35.9	100	1.02
$>10.2 \times 10^9/l$	73.91%	51.6–89.8%	45.24%	29.8–61.3%	42.5	76.0	1.35
$>12.8 \times 10^9/l$	65.22%	42.7–83.6%	71.43%	55.4–84.3%	55.6	78.9	2.28
$>14.9 \times 10^9/l$	47.83%	26.8–69.4%	80.95%	65.9–91.4%	57.9	73.9	2.51
$>20.6 \times 10^9/l$	26.09%	10.2–48.4%	95.24%	83.8–99.4%	75.0	70.2	5.48

WCC = white cell count; CI = confidence interval; +PV = positive predictive value; -PV = negative predictive value; +LR = positive likelihood ratio

Table 3 Predictive value of C-reactive protein

CRP	Sensitivity	95% CI for sensitivity	Specificity	95% CI for specificity	+PV	-PV	+LR
$>51\text{mg/l}$	65.22%	42.7–83.6%	47.62%	32.0–63.6%	40.5	71.4	1.25
$>117\text{mg/l}$	56.52%	34.5–76.8%	64.29%	48.0–78.4%	46.4	73.0	1.58
$>156\text{mg/l}$	47.83%	26.8–69.4%	71.43%	55.4–84.3%	47.8	71.4	1.67
$>194\text{mg/l}$	47.83%	26.8–69.4%	88.10%	74.4–96.0%	68.7	75.5	4.02
$>256\text{mg/l}$	21.74%	7.5–43.7%	90.48%	77.4–97.3%	55.6	67.9	2.28

CRP = C-reactive protein; CI = confidence interval; +PV = positive predictive value; -PV = negative predictive value; +LR = positive likelihood ratio

Table 4 Area under the curve (AUC) and *p*-values for WCC, C-reactive protein levels, platelet count and age

	AUC	<i>p</i> -value
White cell count	0.70	0.005
C-reactive protein	0.66	0.02
Platelet count	0.59	0.19
Age	0.49	0.90

Figure 1 Receiver operating characteristic curve for predicting pathology by increased white cell count (WCC) in women presenting with non-specific lower abdominal pain

A WCC of $>12.8 \times 10^9/l$ was 65% sensitive and 71% specific in predicting subsequent pathology on ultrasonography (Table 2) whereas a CRP of $>194\text{mg/l}$ was 48% sensitive and 88% specific (Table 3). With ROC analysis, CRP was found to be a weak predictor of positive pathology on ultrasonography (AUC=0.66 and $p=0.027$) and WCC was a strong predictor of abnormal pathology (AUC=0.70 and $p=0.005$) (Table 4, Fig 1).

No significant differences were found in the two groups in terms of age, duration of pain, platelet count and length of stay in hospital. The median wait for ultrasonography was 24 hours (range: 1–96 hours).

Discussion

NSLAP in women presents a diagnostic and therapeutic challenge. Ultrasonography is commonly used as first line radiological investigation. This study failed to define any criteria that could reliably and consistently select patients not requiring ultrasonography. A WCC of $>12.8 \times 10^9/l$ was 65% sensitive and 71% specific in predicting subsequent pathology on ultrasonography. However, this sensitivity and

specificity does not reach a level where it could be used as a safe clinical discriminator in avoiding ultrasonography.

Ultrasonography is readily available, cheap and involves no exposure to radiation or contrast. A number of studies have examined the role of ultrasonography in the management of lower abdominal pain. They have demonstrated that use of this imaging modality improves diagnostic accuracy and that the concordance of ultrasonography findings with discharge diagnosis is significant.^{4–8}

In a prospective study by Dhillon *et al* ultrasonography changed the management in a quarter of the 100 patients (ie 15 intended laparotomies were stopped and 7 patients underwent surgery where it was not planned originally).⁹ Nevertheless, this high figure could be attributed to the fact that most of the ultrasonography requests were made by a junior member of the team before the patient was reviewed by a senior (registrar or consultant). The information obtained from the imaging can enable the clinician to avoid surgery in some cases and, if required, to perform the right surgery. However, it should be remembered that ultrasonography should not replace good history taking and examination.^{4,10}

There are certain limitations of using ultrasonography in the routine management of NSLAP. It could be argued that ultrasonography may help in making an earlier diagnosis but it has economic consequences and carries the risk of false reporting as it is operator dependent.¹¹ It can also increase the length of stay in the hospital due to waiting for the scan. This adds to the hospital costs. In the present population there were only 23 patients who had pathology while the remaining 42 had normal imaging. It would therefore be unwise to subject all these patients to a laparoscopy. Although laparoscopy has a low morbidity, its use for all admissions with NSLAP may be unjustified from a risk and cost point of view. Despite limitations, the benefits of ultrasonography on balance outweigh the increased cost associated with its use. The routine use of ultrasonography in NSLAP is therefore probably justified.

This study demonstrates that if the WCC is increased in a patient with lower abdominal pain, it is more likely that the patient will have a positive pathology. It also illustrates that WCC is a better predictor of positive pathology on ultrasonography than CRP. These results are in accordance with past reports.^{12–14} Previous studies suggest that if WCC and CRP levels are normal, presence of pathology is highly unlikely and vice versa.^{15–18} Although most of the studies referred to here investigate the therapeutic impact of WCC and CRP in acute appendicitis, the conclusions can be applied to other intra-abdominal pathology. It is therefore suggested that WCC should be used to prioritise imaging, thereby helping to make the service more efficient and cost effective.

In view of the finding that screening ultrasonography in NSLAP is probably justified, surgeons could be trained to undertake ultrasonography themselves to reduce waiting times, expedite management decisions and decrease costs.¹⁹ A large randomised trial (800 patients) conducted in Sweden by Lindelius *et al* showed that surgeons can be trained to perform ultrasonography.²⁰ The authors concluded that this practice can improve the management of

patients with an acute abdomen, reducing the admission rate and resulting in shorter lead times to surgery. Further studies are warranted to determine the conditions in which ultrasonography performed by surgeons is most beneficial. Although surgeons were evaluated in the Swedish study, the conclusions can be generalised to emergency physicians or general practitioners. The only limiting factor would be the excess resources needed for training the doctors and the associated costs.

The limitations of this study are its retrospective design and the inclusion of patients presenting with loin pain suggestive of renal pathology. It could, however, be argued that patients with NSLAP present with a variable pattern of pain. The present study population is therefore a realistic representation. The above mentioned subgroup of patients would benefit especially from ultrasonography.

Conclusions

Ultrasonography can serve as an important diagnostic tool in the management of women presenting with NSLAP. Increased WCC is a useful indicator in predicting pathology and should be used to prioritise imaging.

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