Leucocyte count and oral temperature are a useful guide to selecting women with right iliac fossa pain for diagnostic laparoscopy

D SINGH-RANGER, A OGADEGBE

Queen's Hospital, Romford, UK

ABSTRACT

INTRODUCTION In women, negative appendectomy rates can be as high as 34%. A 5-fold reduction is possible with diagnostic laparoscopy. A selective policy is favoured as indiscriminate use may increase postoperative morbidity. Scoring systems are helpful but not used widely due to their complexity. The value of leucocyte count and temperature in selecting women with right iliac fossa pain for diagnostic laparoscopy is investigated.

PATIENTS AND METHODS Over a 12-month period, admission leucocyte count and temperature data were obtained from women undergoing appendectomy. Cohorts were sub-categorised by age (< 20, 21–40 and > 40 years) and the proportion of negative (normal appendix) and positive (inflamed, gangrenous or perforated appendix) appendicectomies compared.

RESULTS In 100 women, 11% had leucocyte counts and temperature $\geq 11 \times 10^9/l$ and $38^\circ C$, respectively; all had appendicitis. In 50%, leucocyte counts and temperature were $\geq 11 \times 10^9/l$ and $< 38^\circ C$; negative appendicectomies occurred in 13.8% < 20 years, 10% > 40 years ($P < 0.01$) and 27.3% aged 21–40 years ($P = 0.086$). In 39%, the negative appendectomy rate was $\geq 36.8\%$ when leucocyte count and temperature were $< 11 \times 10^9/l$ and $38^\circ C$ ($P = 0.1$).

CONCLUSION Diagnostic laparoscopy should be considered in all women when leucocyte counts and temperature are $\geq 11 \times 10^9/l$ and $38^\circ C$ and for females aged 21–40 years when these values are $\geq 11 \times 10^9/l$ and $< 38^\circ C$.

KEYWORDS

Appendicitis – Laparoscopy – Women

Accepted 23 January 2010; online publication 10 April 2010

CORRESPONDENCE TO

D. Singh-Ranger

E: dsingh-ranger@nhs.net

Acute right iliac fossa pain in women can present with diagnostic difficulty and may result in an unnecessary appendectomy with retrospective investigations revealing negative appendicectomies as high as 25–40%.¹ Furthermore, it is suggested that up to 2% of women of reproductive age undergoing an open appendectomy may become infertile,² thus exposing those with a normal appendix to an unnecessary risk. In order to minimise the frequency of negative appendectomy and the possibility of infertility, other investigations such as ultrasound, computerised tomography (CT) and diagnostic laparoscopy have been employed.^{3,4} Diagnostic laparoscopy is useful as it can reduce negative appendicectomies from 25% to 4%.⁵ Not all women with right iliac fossa (RIF) pain will need an investigative laparoscopy and so scoring systems have been devised to select those in whom the diagnosis is equivocal (Table 1). These objective assessments are difficult to recall and may explain why they have not been widely adopted.

Leucocyte count and temperature $\geq 11 \times 10^9/l$ and $38^\circ C$ is a consistent feature in these scoring systems; when both

are elevated, the probability of appendicitis is high (> 95%). Furthermore, randomised controlled trials of open versus laparoscopic appendectomy have based the decision for surgery on clinical symptoms and signs, a leucocyte count of $\geq 11 \times 10^9/l$ and temperature of more than $38^\circ C$.⁶ With this in mind, the value of leucocyte count and oral temperature in selecting women with RIF pain for diagnostic laparoscopy was investigated. Potential benefits of using just these two measurements include availability, easy and practical application in a busy emergency unit and the avoidance of complex scoring systems.

Patients and Methods

Over a 12-month period, the admission leucocyte count and oral temperature were obtained from the records of all women that had undergone appendectomy. Junior surgeons conversant with either the open or the laparoscopic techniques of appendectomy performed the operation. At induction, a single dose of intravenous Cefuroxime (1.5 g)

Table 1 Scoring systems used in selecting women with right iliac fossa pain for laparoscopy

Author	Variables
Van den Broek	
A score of 4–6 proceed to laparoscopy	WCC > $10 \times 10^9/l$ Rebound tenderness Male sex Symptoms < 48 h Temperature $\geq 38^\circ\text{C}$
Lamparelli	
In women, if score > 7 proceed to laparoscopy	Migratory pain Anorexia Nausea/vomiting Tenderness RIF Rebound tenderness Temperature $\geq 37.5^\circ\text{C}$ WCC > $13 \times 10^9/l$

and metronidazole (500 mg) antibiotic prophylaxis was given and the wound infiltrated with up to 20 ml of 0.5% levobupivacaine local anaesthetic post procedure. Laparoscopic appendectomy comprised the three-port technique with carbon dioxide pneumoperitoneum at 12–14 mmHg. The open technique involved a muscle splitting incision in the right iliac fossa and for both techniques all appendices were removed. Histology was used to categorize the removed appendices into normal, inflamed, gangrenous and perforated. A negative appendectomy was defined when a histologically normal appendix was removed and a positive one when the appendix was inflamed, gangrenous or perforated.

All patients had abdominal pain that shifted to the right iliac fossa with percussion tenderness and/or guarding in the right iliac fossa. In all cases, the urinary pregnancy test was negative. The potential selection of women for diagnostic laparoscopy was investigated by examining the negative

appendectomy rates for different leucocyte counts and temperature, and in relation to age. Based upon the permutations and combinations of leucocyte count and temperature, women were divided into four cohorts and then subcategorised by age into pre-reproductive (< 20 years), reproductive (21–40 years) and post-reproductive (> 40 years) in accordance with the published literature. The four cohorts comprised (Table 2):

Cohort 1 Leucocyte count greater $\geq 11 \times 10^9/l$ and temperature $\geq 38^\circ\text{C}$.

Cohort 2 Leucocyte < $11 \times 10^9/l$ and temperature $\geq 38^\circ\text{C}$.

Cohort 3 Leucocyte count > $11 \times 10^9/l$ and temperature < 38°C .

Cohort 4 Leucocyte count < $11 \times 10^9/l$ and temperature < 38°C .

Each of the cohorts and age groups underwent a comparison of the proportion of negative and positive appendectomies.

Statistical analysis

The proportion of negative appendectomies was calculated from the formula [number of normal appendices]/[total number of appendectomies] and for positive appendectomies by [number of inflamed, gangrenous, perforated appendices]/[total number of appendectomies]. Statistical significance was assessed with the difference between two proportions and defined as $P \leq 0.05$.

Results

Appendectomy occurred in 105 women but five records were incomplete for temperature and so excluded from further analysis. In 30 women, pre-operative ultrasound did not help in establishing the cause for right iliac fossa pain and CT was not performed. Table 2 shows the number of women in the four cohorts; 50% of women presenting with RIF pain had a leucocytosis ($\geq 11 \times 10^9/l$) and temperature < 38°C (Cohort 2), and 50% had a leucocyte count and temperature of < $11 \times 10^9/l$ and 38°C , respectively (Cohort 4). Not a single woman had a temperature $\geq 38^\circ\text{C}$ and leucocyte count < $11 \times 10^9/l$ and all (11%) with a leucocytosis and temperature $\geq 38^\circ\text{C}$ had a histological diagnosis of appendicitis. Figure 1 shows the negative and positive appendectomies for cohorts 2 and 4 in relation to age. In Cohort 2, women of < 20 years had negative and positive appendectomies of 13.8% and 86.2% ($P = 0.000$). Those that were > 40 years old had negative and positive appendectomies of 10% and 90%, respectively ($P = 0.001$), whereas women of reproductive age (21–40 years) had values of

Table 2 Number of women in each cohort

Cohort	Leucocyte count ($\times 10^9/l$)	Temp. ($^\circ\text{C}$)	Age (years)		
			≤ 20	21–40	> 40
1	≥ 11	≥ 38	7	4	0
2	≥ 11	< 38	29	11	10
3	< 11	≥ 38	0	0	0
4	< 11	< 38	19	14	6

27.3% and 72.7%, respectively ($P = 0.086$). In Cohort 4, females of < 20 years had negative and positive appendicectomies of 36.8% and 63.2% ($P = 0.194$); 42.9% and 57.1% of women of reproductive age (21–40 years) had negative and positive appendicectomies ($P = 0.706$), whereas those > 40 years showed values of 50% each, respectively ($P = 1.000$).

Discussion

This study suggests that leucocyte count and temperature would be useful in selecting women with RIF pain for diagnostic laparoscopy. The investigation would be useful in women of all ages with a leucocyte count and oral temperature of $< 11 \times 10^9/l$ and $38^\circ C$ and in those aged between 21–40 years with a leucocytosis and oral temperature $< 38^\circ C$.

It could be argued that diagnostic laparoscopy increases peri-operative morbidity¹⁰ favouring pre-operative radiological

imaging is preferable. The two imaging modalities frequently used are ultrasound and computerised tomography (CT). The former is highly observer dependent and the latter exposes women to high levels of ionising radiation (equivalent to 100–250 plain chest radiographs). Computerised tomography has been shown to have a sensitivity and positive predictive value of 95% and, as an investigative tool for right iliac fossa pain, is of more value in females than males.⁵ The disadvantage is that the differentiation between appendicitis and other pathology (e.g. ruptured ovarian cyst) is difficult or the appendix may not be visualisable. In a retrospective study, McDonald *et al.*⁷ suggested that the routine use of CT had not decreased negative appendectomy rates in women but the findings could have been confounded by unavailable expert radiological reporting and image resolution (*i.e.* not multislice). In a randomised trial, CT and ultrasound were better at suggesting acute appendicitis than the clinical findings in children (mean age, 10.4 years; range, 2–15 years); CT had better diagnostic accuracy than ultrasound (95% vs 89%; $P < 0.001$) but these patients had undergone ultrasonography prior to CT and blinding of the former during CT interpretation was not mentioned.⁸ Others have suggested that CT and ultrasonography were no better than a history of migratory pain, right iliac fossa tenderness and leucocytosis in the diagnosis of acute appendicitis.⁹ With laparoscopy, a diagnosis was made in 97% of women and only in 28% that had CT or ultrasound. Out of 38 women < 50 years of age, 26 had acute appendicitis on diagnostic laparoscopy and only five of these had a positive confirmation on pelvic ultrasonography.⁵

Scoring systems that decide the need for diagnostic laparoscopy are available and require the collection of several variables to which scores based upon regression methods have been assigned. A cumulative score above a high critical value favours immediate appendectomy whereas below a minimum critical value observation is indicated. Between these two values patients have diagnostic laparoscopy. They have not been widely adopted into clinical practice partly because of the need for validation and their impracticality in a busy surgical emergency unit. Leucocyte count and temperature are objective measures routinely obtained and available in all units. Furthermore, they are not linked to scoring systems and can be used to select women for diagnostic laparoscopy.

Conclusions

This investigation has shown that leucocyte count and temperature may be used to select women with acute RIF pain for diagnostic laparoscopy. It is proposed that laparoscopy should be considered in all women with a leucocyte count and temperature of $< 11 \times 10^9/l$ and $38^\circ C$ where the suspicion of appendicitis is high and probably in women of reproductive age (21–40 years) where there is a leucocytosis but oral

temperature is < 38°C. Postoperative morbidity is likely to be kept at a minimum with such a policy.

References

1. Larsson PG, Henriksson G, Olsson M, Boris J, Ströberg P, Tronstad SE *et al.* Laparoscopy reduces unnecessary appendectomies and improves diagnosis in fertile women. A randomized study. *Surg Endosc* 2001; **15**: 200–2.
2. Singh-Ranger D, Sanusi A, Hamo I. Coliform pyosalpinx as a rare complication of appendectomy: a case report and review of the literature on best practice. *J Med Case Reports* 2008; **2**: 97.
3. Wagner PL, Eachempati SR, Soe K, Pieracci FM, Shou J, Barie PS. Defining the current negative appendectomy rate: for whom is preoperative computed tomography making an impact? *Surgery* 2008; **144**: 276–82.
4. Stunell H, Aremu M, Collins D, Torreggiani WC, Conlon KC. Assessment of the value of pelvic ultrasonography in pre-menopausal women with right iliac fossa pain. *Ir Med J* 2008; **101**: 216–7.
5. van Dalen R, Bagshaw PF, Dobbs BR, Robertson GM, Lynch AC, Frizelle FA. The utility of laparoscopy in the diagnosis of acute appendicitis in women of reproductive age. *Surg Endosc* 2003; **17**: 1311–3.
6. Katkhouda N, Mason RJ, Towfigh S, Gevorgyan A, Essani R. Laparoscopic versus open appendectomy: a prospective randomized double-blind study. *Ann Surg* 2005; **242**: 439–48.
7. McDonald GP, Pendarvis DP, Wilmoth R, Daley BJ. Influence of preoperative computed tomography on patients undergoing appendectomy. *Am Surg* 2001; **67**: 1017–21.
8. Kaiser S, Frenckner B, Jorulf HK. Suspected appendicitis in children: US and CT – a prospective randomized study. *Radiology* 2002; **223**: 633–8.
9. Lee SL, Walsh AJ, Ho HS. Computed tomography and ultrasonography do not improve and may delay the diagnosis and treatment of acute appendicitis. *Arch Surg* 2001; **136**: 556–62.
10. Singh-Ranger D, Taneja T, Sroden P, Peters J. A rare complication following laparoscopic TEP repair: case report and discussion of the literature. *Hernia* 2007; **11**(5): 453–6.