Long-term hospital attendance of children and adults who have undergone removal of normal or inflamed appendices

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Background Early studies suggested that presentations with unexplained acute abdominal pain were associated with increased long-term rates of hospital attendance and self-harm, especially in women, but few studies were large enough for definitive findings.

Aims To test the hypothesis that such presentations are followed by higher long-term utilisation rates of secondary health care even excluding further abdominal symptoms, and particularly for self-harm, than presentations with acute appendicitis.

Method New hospital attendance rates, liaison psychiatry attendances and self-harm attendances of patients with normal appendices at emergency appendicectomy were compared with those of appendicitis patients.

Results Attendance rates of all kinds were significantly higher for normal appendix patients than for appendicitis patients, with equal strengths of finding for males and females.

Conclusions People with normal appendices at emergency appendicectomy show higher long-term rates of hospital attendance. This has implications for how these patients are best managed by health care systems.

Declaration of interest None.

Despite advances in diagnostic technology, no appendix abnormality is found in up to 40% of the 70 000 urgent appendicectomies performed annually in the UK. Careful clinical assessment (Douglas *et al*, 2000) and close 'active clinical observation' (Pledger & Stringer, 2001) remain paramount in reducing mortality and morbidity. Previous studies have suggested, particularly in women, an excess of subsequent hospital admissions for abdominal pain (Joyce *et al*, 1981) and higher rates of psychiatric morbidity and of self-harm (Vassilas, 1988) following negative appendicectomy, but none has had sufficient statistical power for definitive findings. Barker & Mayou (1992) argued that presentations with acute abdominal pain but without clear underlying pathology represent a behavioural syndrome with poor prognosis in terms of long-term utilisation of hospital resources. Persistent childhood abdominal pain is associated with higher subsequent risk of adult psychiatric disorder (Hotopf *et al*, 1998) and increased rate of unexplained hospital admissions between 15 years and 43 years of age (Hotopf *et al*, 2000). Subsequently, much work has highlighted the importance of psychosocial determinants of health care utilisation and emphasised the need for hospital practitioners to consider such factors in addition to an exclusively medical model in dealing with such attendances (Mayou, 1997). Major life events commonly precede appendicectomy in adults (Creed, 1989; Beaurepaire *et al*, 1991), and those with psychiatric symptoms at time of operation experience less relief of abdominal pain following surgery (Creed, 1989). The present study investigated whether secondary health care utilisation, particularly presentation with self-harm, is still significantly more common over the long term in people found to have no evident causative histopathological change at emergency appendicectomy than in people with confirmed acute appendicitis, and whether gender effects suggested by earlier studies are significant.

METHOD

This retrospective case-note cohort study was set in the West Leeds group of hospitals providing the full range of acute and routine health services to the resident population. Local ethical approval was obtained.

Sample

The sample size was determined by examining the records of a random sample of 20 patients who had attended a West Leeds hospital at least once since 1984 and noting the number of recorded hospital attendances for each patient. These data (mean 1.4 attendances over 16 years, s.d.=0.84) indicated that at 5% significance level and 80% power, 253 normal appendix cases and 253 inflamed appendix comparisons would be needed to detect a difference in means of 0.2 (15%).

To provide at least 15 years' post-operative observation, histology records were scrutinised for consecutive appendix specimens removed in West Leeds hospitals from 1984 onwards. The pathologist (N.J.M.) excluded patients with indeterminate tissue findings, and assigned 336 patients whose appendices had no pathologic change to a 'normal appendix' group and 333 patients whose appendices were acutely inflamed to an 'inflamed appendix' comparison group. Equal numbers of cases from each group were taken for each year of sampling to reduce differential cohort effects. Case notes were untraceable for 168 patients (82 from the 'normal appendix' group and 86 from the 'inflamed appendix' group). Case notes for each of the remaining patients were obtained, and N.J.M. excluded a further 25 patients (20 normal appendix and 5 inflamed appendix) where other causative tissue changes (for example, a ruptured ovarian cyst) had been evident at laparotomy or where appendicectomy had not followed a clinical suspicion of acute appendicitis. The second researcher (N.J.D.), masked to appendix histological status (normal or inflamed) of each patient, then scrutinised the notes for every hospital contact at any of the West Leeds hospitals over the patient's lifetime to quantify attendance data up to the year

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2000. Finally, 20 patients over 65 years of age at the time of the study were excluded.

Measures

The general measure of attendance chosen for this study was lifetime new hospital attendance rate expressed as attendances per notional 100 years. This was, for each patient, calculated from the sum of new out-patient appointments actually attended, case note records of attendances at accident and emergency departments (attendances resulting in admission and therefore entries in the hospital case notes), and unplanned in-patient and out-patient attendances over the patient's lifetime (i.e. from birth to the study date), divided by the patient's age at the study date. This measure therefore included attendances both before and after appendicectomy, but excluded routine follow-up visits and planned admissions. New attendance rates were chosen because, first, the focus of interest in this study was the point of entry into the hospital system, which is more related to patient (and referrer) variables than within-hospital activity, which is more strongly determined by hospital medical staff. Second, the preliminary audit showed total (new and follow-up visit) attendance data to be so widely distributed about the mean that sample sizes of thousands of cases would be necessary to show group differences with any degree of certainty. In comparison, lifetime new hospital attendance data were far more closely distributed about the mean. The audit also showed that thousands of patients would be required to make comparisons between actual hospital in-patient episodes because these were much rarer events.

Records of clinical contacts over each patient's lifetime were scrutinised and the nature of the presenting complaint on each occasion was recorded. Presentations as a result of deliberate self-harm and attendances at hospital liaison psychiatry services were noted. Occasions on which patients had presented with anterior abdominal pain that was not clearly attributable to another organ system (for example, a clear history of menorrhagia or confirmed urinary tract infection) were also specifically recorded. This enabled calculation of 'non-abdominal' attendance rates by excluding presentations that might have been due to residual undetected abdominal disease and therefore possibly overrepresented in the 'normal appendix' group.

Statistical analyses

Attendance rates were found to be skewed, with a large proportion of each group having an attendance rate of zero (no other hospital contact than the index appendicectomy admission). Non-parametric tests were therefore applied to differences in attendance rates between subject and comparison groups using the Statistical Package for the Social Sciences (SPSS, 2001). Variables such as attendances with self-harm or liaison psychiatry attendances, where values were commonly zero, were converted to binary variables indicating presence or absence but with no magnitude of the variable for each case. Relative risk calculations using 2×2 tables and the formula of Altmann (1991: p. 267) and logistic regression were then performed to compare groups. The sample was further subdivided by gender and age at appendicectomy to yield a childhood appendicectomy group (ages up to and including 18 years) and an adult appendicectomy group (ages 19 years and above), and attendance rates were then compared for normal appendix and inflamed appendix patients within these subgroups. The effects on hospital attendance of age, of appendix histology, of age at appendicectomy and of gender were further investigated by regression analysis of total lifetime new hospital attendance.

RESULTS

The final analysis included 456 patients (229 from the normal appendix group and 227 from the inflamed appendix group). Table 1 shows gender distributions and median values for present age, and age at appendicectomy for children and adults, according to histological findings. There were significant age and gender differences between groups (see below). Gender and median age distributions for all exclusions and exclusions from the two main comparison groups are shown in Table 2. These data include cases excluded because notes could not be traced, but in order to make age comparisons meaningful do not include the small number of cases excluded because the patients were aged 65 years or over. These show broadly the same gender and age distributions for each comparison as the sample groups included in the study.

All attendance rates of all kinds studied were higher for patients in the 'normal appendix' group than for the 'inflamed appendix' patients for the entire sample and for every subgroup studied (Tables 3, 4 and 5). These findings held at the 5%

Table 1 Age and gender distributions for child and adult normal appendix and inflamed appendix patients

	All	Normal	Inflamed
All appendicectomies			
Number of cases (*n*)	456	229	227
Median present age (years)	32	32	33
Median age at appendicectomy (years)	20	19	20
Male gender (%)	50	39[1]	61[1]
Childhood appendicectomies			
Number of cases (*n*)	201	99	102
Median present age (years)	27	28[2]	25[2]
Median age at appendicectomy (years)	14	15[3]	13[3]
Male gender (%)	55	41[4]	69[4]
Adult appendicectomies			
Number of cases (*n*)	255	130	125
Median present age (years)	37	37	37
Median age at appendicectomy (years)	24	24	24
Male gender (%)	46	37[5]	54[5]

1. Pearson $\chi^2=21.9$, d.f.=1, $P<0.001$.
2. Mann–Whitney U, $Z=-3.3$, $P=0.001$.
3. Mann–Whitney U, $Z=-3.6$, $P<0.001$.
4. Pearson $\chi^2=15.0$, d.f.=1, $P<0.001$.
5. Pearson $\chi^2=7.9$, d.f.=1, $P=0.005$.

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Table 2 Age and gender distributions for exclusions from normal appendix and inflamed appendix patient groups

	All	Normal	Inflamed
Number of cases (*n*)	213	107	106
Median present age (years)	34	33	34
Male gender (%)	51	41	56

Table 3 Annualised lifetime hospital attendance rates for normal and inflamed appendix patient groups for all attendances and for 'non-abdominal' attendances

	All	Normal	Inflamed
Number of cases (*n*)	456	229	227
Number with no other attendances (*n* (%))	132 (29)	50 (22)	82 (36)
Attendance rate (median (IQR))	4.4 (0.0–10.8)	6.5 (2.2–13.8)	3.4 (0.0–8.8)
Non-abdominal attendance rate (median (IQR))	3.7 (0.0–9.5)	5.4 (0.0–11.1)	2.9 (0.0–7.0)

IQR, interquartile range.

Table 4 Statistical comparisons of median lifetime new attendance rates for entire sample and appendicectomy age and gender subgroups

Subgroup by gender	Lifetime new attendance rates: ratio of normal appendix group to inflamed appendix group (Mann–Whitney *U*)	
	All attendances	Non-abdominal attendances
All appendicectomies		
All	**1.9** ($Z=-4.1$, $P<0.001$)	**1.9** ($Z=-3.7$, $P<0.001$)
Males	**1.8** ($Z=-2.4$, $P=0.017$)	**1.8** ($Z=-3.3$, $P=0.001$)
Females	**2.5** ($Z=-3.4$, $P=0.001$)	**2.1** ($Z=-2.9$, $P=0.004$)
Childhood appendicectomies		
All	1.3 ($Z=-1.9$, $P=0.064$)	1.6 ($Z=-1.6$, $P=0.110$)
Males	1.1 ($Z=-0.4$, $P=0.682$)	1.2 ($Z=0.682$, $P=0.773$)
Females	**2.1** ($Z=-2.4$, $P=0.019$)	**1.9** ($Z=-2.0$, $P=0.041$)
Adult appendicectomies		
All	**2.2** ($Z=-3.9$, $P<0.001$)	**1.6** ($Z=-3.8$, $P<0.001$)
Males	**2.6** ($Z=-3.2$, $P=0.002$)	**2.6** ($Z=-3.2$, $P=0.001$)
Females	**1.6** ($Z=-2.2$, $P=0.031$)	1.3 ($Z=-1.9$, $P=0.059$)

Results significant at the 5% level are shown in bold.

level of significance for the entire sample and held consistently for both male and female subgroups and for childhood and adult appendicectomy subgroups, but with varying degrees of strength – with inevitable losses of statistical precision being due to the smaller sizes of these subgroups (Tables 4 and 5).

Lifetime new hospital attendances and 'non-abdominal' attendances

For the entire sample, the median lifetime new attendance rate of the normal appendix patients (6.5 attendances per notional 100 years) was 1.9 times that of the inflamed appendix patients (3.4 attendances per notional 100 years) (Table 3). This finding held even when presentations with abdominal symptoms were excluded: for the entire sample, median lifetime new 'non-abdominal' attendance rate of the normal appendix patients (5.4 attendances per notional 100 years) was 1.9 times that of the inflamed appendix patients (2.9 attendances per notional 100 years) (Table 3). These findings remained significant both for all males and for all females in the whole sample, when analysed separately (Table 4).

Deliberate self-harm and psychiatric attendances

For the entire sample, the percentage of normal appendix patients attending hospital with deliberate self-harm (7.9%) was 3.6 times that for inflamed appendix patients (2.2%), a significantly raised relative risk (Table 5). For the entire sample, the percentage of normal appendix patients with psychiatric attendances (10.5%) was 2.6 times that for inflamed appendix patients (4.0%), also a significantly raised relative risk (Table 5).

Calculations using logistic regression produced similar results, although with consistently higher values both for the estimates of relative risk and for the upper confidence limits for both deliberate self-harm and liaison psychiatry attendances. Table 5 gives the more conservative results.

Gender effects

Subgroup analyses by gender and age at appendicectomy (Tables 4 and 5) showed no significant overall effect of female gender. Regression analysis to look at the effects of gender, age, appendix histology (normal or inflamed) and age at appendicectomy on

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Table 5 Relative risks of self-harm and psychiatric attendances for entire sample and appendicectomy age and gender subgroups

Subgroup by gender	Relative risk of self-harm for normal *v.* inflamed group (95% CI)	Relative risk of psychiatric attendances for normal *v.* inflamed group (95% CI)
All appendicectomies		
All	**3.6** (1.3–9.5)	**2.7** (1.3–5.2)
Males	**3.5** (1.1–11.1)	**4.3** (1.4–13.2)
Females	5.7 (0.7–44.2)	1.6 (0.6–4.5)
Childhood appendicectomies		
All	**4.6** (1.0–20.9)	**3.7** (1.1–12.8)
Males	4.1 (0.8–20.4)	**8.3** (1.0–68.6)
Females	ND[1]	1.8 (0.4–8.2)
Adult appendicectomies		
All	2.9 (0.9–8.4)	2.1 (0.8–5.3)
Males	3.1 (0.6–15.7)	3.1 (0.8–11.4)
Females	3.3 (0.4–27.8)	1.6 (0.4–5.8)

Results significant at the 5% level are shown in bold.
1. Result incalculable owing to absence of any self-harm attendance in the inflamed appendix group.

total hospital attendance showed that only appendix histology had significant influence on the total number of new hospital attendances (Table 6).

DISCUSSION

Our study is based on a large consecutive sample from a group of hospitals likely to be representative of those serving many urban areas and is the only study we are aware of that has investigated hospital attendance following appendicectomy as recently as the year 2000.

Increased lifetime hospital attendance

In this study, people who underwent emergency removal of a normal appendix tended to account for nearly twice as many new hospital encounters over their lifetime as did those with acute appendicitis, even when further presentations with possible undiagnosed abdominal disease are excluded. This result is therefore not just the result of persistent undiagnosed abdominal disease in the 'normal appendix' group. The fact that attendance rates were not binomially distributed in this group (Table 3) suggests that the results are not just owing to the behaviour of a frequently attending minority. These findings confirm earlier reports of non-significant trends in smaller studies, and suggest that increased hospital attendance is an enduring behavioural trait, probably related to increased contributions from psychosocial factors, as suggested in earlier studies.

Self-harm and liaison psychiatry attendance

The hospital attendance discrepancy between the normal and inflamed appendix groups shows a nearly four-fold ratio for self-harm and attending liaison psychiatry. These results also confirm earlier findings of non-significant trends in smaller studies.

Table 6 Regression analysis of the effects of gender, age, age at appendicectomy and appendix histology (normal or inflamed) on total admissions to hospital

	b	Significance	95% CI for *b*
Constant	1.11	0.216	0.03 to 3.60
Appendix histology	1.16	<0.001	0.79 to 1.54
Age	0.23	0.85	−0.10 to 0.13
Age at appendicectomy	0.27	0.75	−0.10 to 0.14
Gender	−0.46	0.91	−0.60 to 0.53

Note: r^2 for model is 0.048.

Gender and age effects

Unlike previous studies, this study finds no significant overall effect of female gender. Gender differences between normal and inflamed appendix groups do not appear to have contributed to the results in an important way. Gender effects may, of course, be strongly culturally determined and have reduced since earlier studies. The regression analysis of total hospital attendance also suggests that gender, age, and age at appendicectomy differences between the normal and inflamed appendix groups have not contributed significantly. The study exclusion criteria do not appear to have influenced gender or age distributions between comparison groups, since gender and age distributions for included and excluded cases from each comparison group are broadly the same.

Limitations of the study

A weakness of this study is that it was not prospective, but outcome events all preceded data collection, which was carried out masked to appendix histology. Second, it is undoubtedly the case that significant migration would have occurred over the course of these case histories and many patients would have been lost to follow-up. There is no reason to believe, however, that migration would have affected the comparison groups differentially to produce a systematic bias. A further weakness is that attendance figures have not included all accident and emergency attendances because only those resulting in hospital admission were recorded in the in-patient medical record. However, there are no grounds to suspect that this incompleteness of data has biased the comparisons made. Additionally, we made no attempt to trace hospital contacts at the other large Leeds hospital because we judged that disregarding such attendances would also not introduce systematic bias into the study.

Clinical implications

Children and adults found to have a normal appendix at emergency appendicectomy have a significantly higher number of lifetime hospital attendance for all presentations, and not simply further

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abdominal presentations, than people found to have acute appendicitis. They are also at significantly higher risk of the adverse outcomes of self-harm and psychiatric disturbance. Emergency removal of a normal appendix is a frequent treatment event; identifying and helping patients to tackle underlying psychosocial problems that have been repeatedly shown to increase health care-seeking behaviour should yield clinical and financial benefits. This has implications for clinicians and managers. It is of note that very few case records in this study reported (either in the case notes themselves or in the accompanying nursing notes) the giving of advice or assistance for even extreme psychosocial stressors. Certainly, a large number of comments recorded in the medical notes implied continuing adherence to an exclusively medical model for illness presentation and management, for example: 'I am convinced there is no surgical cause for these symptoms, but I have no choice but to operate'; 'I have reassured this patient four times today and still there is no improvement'; and 'threatened to take an overdose if not seen by a surgeon – orthopaedic surgeon to see urgently please'.

CLINICAL IMPLICATIONS

- Patients who have had emergency removal of a normal appendix continue enduringly as a group to attend hospital, particularly with self-harm, far more frequently than people who present with acute appendicitis. They also have a higher rate of attendance to liaison psychiatry.
- Removal of a normal appendix may represent an opportunity for intervention early in the hospital career of a group of patients for whom psychosocial factors are significant determinants of health care-seeking behaviour and who are otherwise at risk of further frequent hospital attendance in the long term.
- Hospital staff must have an awareness of psychosocial determinants of illness presentation and be able to direct patients to both hospital-based and external statutory, independent and voluntary resources for addressing psychosocial morbidity.

LIMITATIONS

- Although outcome events all preceded data collection, the study was not a prospective study.
- Significant migration of patients of all groups will have occurred, both in and out of the hospital catchment area, meaning survival analysis techniques could not be used for statistical comparisons.
- Attendance at liaison psychiatry is the only indicator of psychosocial morbidity measured. No broader measures of psychosocial morbidity have been used.

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