ORIGINAL ARTICLE

Serosal appendicitis: incidence, causes and clinical significance

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Background: Serosal appendicitis is a histopathological diagnosis of an inflammatory reaction on the surface of the appendix caused by an extra appendiceal source of inflammation.

Objective and methods: A retrospective review of a pathology database in a district general hospital identified patients with serosal appendicitis and a preoperative diagnosis of appendicitis. Two groups emerged: patients with serosal appendicitis secondary to a known cause of intra-abdominal inflammation and those in whom the cause remained unknown. The groups were compared with respect to postoperative complications, referral to outpatient clinics, admissions and procedures by case-note analysis.

Results: The incidence of serosal appendicitis was 0.01% (19/1379); 17 women; mean age 31.63 (10.49) years. Lanz incision was used in 16 patients, midline laparotomy in two and laparoscopy in one. A preoperative ultrasound scan was carried out in 5 of 19 patients. The cause of serosal appendicitis was confirmed in eight patients (intraoperatively or postoperatively) and remained unknown in 11 patients. The groups were comparable with respect to age, sex and mean follow-up. No significant difference was observed between them with respect to the above parameters.

Conclusions: No further investigation is necessary in patients who undergo an appendectomy but in whom the pathological diagnosis is serosal appendicitis. However, considering the patient demographics and the fact that patients with serosal appendicitis have probably undergone an unnecessary appendectomy, the proportion of patients who underwent ultrasound scanning and diagnostic laparoscopy was small.

Serosal appendicitis may be defined as an inflammatory reaction on the surface of the appendix caused by an extra-appendiceal source of inflammation.¹ It is a pathological diagnosis that is rarely encountered in surgical practice. It is an expected finding when the appendix is excised in the course of an operation for an inflammatory process such as diverticulitis. However, the diagnosis is of concern when the appendix is excised for presumed acute appendicitis, as it suggests that the primary cause of intra-abdominal inflammation has been missed. The aims of this study were to determine (1) the incidence of serosal appendicitis, (2) its causes and (3) the clinical significance of a pathology report of serosal appendicitis when the preoperative diagnosis was appendicitis—that is, whether further investigation is necessary in these patients.

METHODS

The local ethics committee approved the study. Between 1996 and 2002, 1379 appendiceal specimens were analysed by the pathology department of a district general hospital (Milton Keynes). The pathology department database was reviewed retrospectively to identify patients with a pathology report of serosal appendicitis. Their case notes were analysed with respect to age, sex, nature and duration of symptoms, preoperative investigations, preoperative diagnosis, operative details and diagnosis, final diagnosis, and follow-up, and the findings were tabulated.

Patients with a preoperative diagnosis of acute appendicitis who had serosal appendicitis secondary to a known cause of intra-abdominal inflammation were compared with those in whom the cause was unknown, with respect to visits to the accident and emergency department, referral to outpatient clinics, admissions and procedures. All relevant entries in the case notes from the date of admission before undergoing the

appendectomy to the date the notes were analysed were considered to be follow-up data. If there was a change in domicile, we did not attempt to contact the patients or their general practitioner, as we did not have ethical approval for the same.

All parametric data were expressed as mean (standard deviation (SD)). Statistical comparisons were carried out using Fisher's exact test; $p < 0.05$ was considered significant.

RESULTS

Of the 1379 appendixes examined (table 1), there were 811 (58.81%) reports of true appendicitis (inflammation or perforation) and 20 (1.45%) reports of serosal appendicitis.

Table 1 Pathological diagnosis in the 1379 appendixes examined

Diagnosis	n
Acute inflammation	691
Non-inflamed	504
Perforation	115
Serosal appendicitis	20
Endometriosis	7
Carcinoid	7
Metastases	6
Subacute inflammation	5
Acute and chronic inflammation	5
Granulomatous inflammation	5
Mucinous adenocarcinoma	4
Chronic inflammation	3
Atrophy	2
Endosalpingiosis	2
Polyp	2
Cystadenofibroma	1

Table 2 Pathological diagnosis in the 504 non-inflamed appendixes

Diagnosis	n
Normal	384
Fibrous obliteration	64
Faecolith/impacted faeces	29
Enterobius vermicularis	25
Melanosis	2

Of the 504 non-inflamed appendixes (table 2), 202 were resected at operations for benign and malignant colorectal or gynaecological conditions. Of the 20 patients with serosal appendicitis, one had a preoperative diagnosis of acute diverticulitis and underwent an appendectomy in the course of a laparotomy and Hartmann's procedure. Thus, there were 19 patients (2 men and 17 women) with serosal appendicitis and a preoperative diagnosis of acute appendicitis. Their mean age was 31.63 (SD 10.49, range 16–51) years. In these patients, true appendicitis had been ruled out as the cause of serosal appendicitis by taking multiple sections along the length of the appendix.

All patients presented with abdominal pain; the mean duration of symptoms was 4.5 days (SD 6.1 days, median 3 days, range 8 h–1 month). All patients underwent preoperative blood tests for white cell count and estimation of C reactive protein. In all, 12 of 19 (63.15%) patients had an increased white cell count (normal range $4\text{--}12 \times 10^9/\text{dl}$) and 18 of 19 (94.73%) patients had an increased C reactive protein concentration (normal range 0–6 U/l). Of the 19 patients, 18 had a mid-stream urine sample microscopy preoperatively, of which five samples were abnormal in that they contained >50 white cells per high-power field, but the urine cultures were all negative. Only 5 of 19 (26.3%) patients underwent an ultrasound scan, of which two suggested an abnormality; the other three were reported as normal. Of the two abnormal scans, one reported appendicitis and the other an inflammatory mass in the right pelvis.

The mean time to surgery after admission was 1 day. All patients received cephalosporin/cefuroxime (750 mg/1.5 g) and metronidazole 500 mg intravenously at the induction of anaesthesia. Appendectomy was carried out through a Lanz incision in 16 patients, a lower midline incision in two patients and laparoscopically in the remaining patient. The operative diagnoses were as follows: inflamed appendix, $n = 7$; tubo-ovarian abscess, $n = 6$; mucopurulent exudate of unknown cause, $n = 4$; Crohn's disease, $n = 1$; and torsion of the ovary and tube, $n = 1$.

Thus, in seven patients, a diagnosis other than acute appendicitis was made at surgery, and stool cultures showed *Campylobacter* infection in another patient before discharge.

Patients diagnosed with a tubal abscess received a week's course of oral cephalosporin, metronidazole and doxycycline. Patients in whom a mucopurulent exudate was noted received a 5–7-day course of oral cephalosporin and metronidazole.

Two cohorts of patients emerged at this stage: (1) those with serosal appendicitis of known cause, $n = 8$ and (2) those with serosal appendicitis of unknown cause, $n = 11$. These two groups were comparable with respect to age, sex ratio and period of follow-up. Visits to the clinic or accident and emergency department made after referral by a general practitioner or because of recurrence of symptoms, surgical admissions, investigations (not requiring general or regional anaesthesia) and procedures (not counted as admission) were identified from the case notes (tables 3 and 4).

No postoperative complications were seen in either group. After a mean follow-up of about $3\frac{1}{2}$ years, we found no significant difference between the two groups in terms of visits to the clinic or accident and emergency department ($p = 0.823$), admissions ($p = 0.340$), investigations ($p = 0.340$) or procedures ($p = 0.624$).

DISCUSSION AND CONCLUSIONS

Appendicitis is the most common cause of acute abdominal pain and requires surgical intervention. It has been reported that 15–30% of all appendicectomies are unnecessary because of a non-inflamed appendix.² Although the actual incidence of acute appendicitis varies, the overall lifetime risk for acute appendicitis is 6–20%.^{3,4} A US study reported an actual incidence of 8.6% for males and 6.7% for females, compared with an overall lifetime risk for appendicectomy of 12% for males and 23.1% for females.³

Serosal appendicitis is an important diagnosis to make as it indicates an extra-appendiceal source of inflammation resulting in an inflammatory reaction on the surface of the appendix.¹ The inflammation involves the serosa and subserosa, with the infiltrate not extending further than the outer muscularis propria.⁵ Although previous studies have considered appendicitis as a cause for serosal appendicitis,⁶ we did not, as our aim was to determine the consequences of not diagnosing the intra-abdominal inflammatory process that resulted in serosal appendicitis. Indeed, acute appendicitis is reported to be the most common cause of serosal appendicitis, followed by gynaecological and urological disorders.⁶

In our study, 16 of 19 patients with serosal appendicitis were women and aged 20–50 years. This is in contrast with

Table 3 Details of patients with serosal appendicitis of known cause ($n = 8$)

Number	Age	Sex	Referrals/admissions/investigations/procedures	Diagnosis
1	27	F	Nil	R tubal abscess
2	22	F	GUM clinic in 2 months–gonorrhoea	R tubal abscess
3	26	F	Nil	R tubal abscess
4	28	M	Nil	<i>Campylobacter</i> gastroenteritis
5	49	F	Nil	R tubo-ovarian abscess
6	34	F	Clinic visits–1 month/17 months post operation with RIF pain Lap+dye test 19 months post operation—blocked tubes TAH+BSO 32 months post operation	R tubal abscess
7	16	F	Nil	Torsion of L ovary and tube
8	35	F	Nil	R tubo-ovarian abscess

F, female; L, left; M, male; R, right; GUM, genito-urinary medicine; RIF, right iliac fossa; Lap, laparoscopy; TAH, total abdominal hysterectomy.

Table 4 Details of patients with serosal appendicitis of unknown cause (n = 11)

Number	Age	Sex	Referrals/admissions/investigations/procedures	Diagnosis
1	25	F	Nil	Unknown
2	26	F	Admission in 3 weeks	Unknown
3	46	F	Admission in 14 months, small-bowel study-normal	Unknown
4	29	F	Clinic visit in 40 months, Lap+ dye test in 41 months-normal	Secondary infertility
5	19	F	Nil	Unknown
6	31	F	A&E visit in 22 months Clinic visit in 25 months	Unknown
7	37	F	Change of domicile	Unknown
8	26	F	Nil	Unknown
9	20	F	Nil	Unknown
10	51	M	Nil	Unknown
11	46	F	Admission in 24 months, admission in 38 months, barium enema, sigmoid colectomy in 47 months	Diverticulitis

A&E, accident and emergency department; F, female; M, male; lap, laparoscopy.

the fact that 60% of patients with histologically proven appendicitis in the same age range are men. This suggests a preponderance of serosal appendicitis in fertile women.

Interestingly, only 5 of the 19 patients underwent a preoperative ultrasound scan. Although various studies report a wide range in the sensitivity and specificity of ultrasound in diagnosing appendicitis, it is a valuable modality in the evaluation of acute pelvic pain in premenopausal women.⁷ A study assessing the contribution of transvaginal and transabdominal ultrasound in the diagnosis of acute appendicitis concluded that transvaginal in conjunction with transabdominal ultrasound could improve the detection rate.⁸ As 16 of the 19 patients with serosal appendicitis were premenopausal women, and 7 of the 9 patients who had an intraoperative diagnosis had tubo-ovarian pathology, a preoperative ultrasound scan might have resulted in an accurate diagnosis or suggested a diagnostic laparoscopy in a large number of patients. Perhaps the use of other imaging modalities such as computed tomography may improve the diagnostic accuracy in patients with equivocal symptoms and signs of appendicitis. A prospective study on 100 such patients to establish the diagnostic accuracy of modified focused appendiceal computed tomography reported a sensitivity of 93% and a specificity of 97%, with an overall accuracy of 96%.⁹

Our study showed that 16 of the 19 patients with serosal appendicitis were fertile women; this is not surprising given that, excluding true appendicitis, gynaecological causes are the most important cause of serosal appendicitis. In a prospective study on 110 women aged 15–47 years with abdominal pain, listed for an appendectomy, randomised to either open appendectomy or diagnostic laparoscopy followed by open appendectomy if indicated, a gynaecological diagnosis was found in 73% of women with a healthy appendix after laparoscopy compared with 17% after open surgery.¹⁰ The fact that diagnostic laparoscopy was used in only 1 of the 19 patients with a preoperative diagnosis of acute appendicitis could be the reason for the lack of a true diagnosis made in the 11 patients with serosal appendicitis. In another prospective randomised trial carried out to assess the value of laparoscopy in the accurate diagnosis of appendicitis in women of childbearing age, 38% of patients in the study group did not require an appendectomy. Of the 30 appendectomies carried out laparoscopically, only 4 (13%) showed no histological abnormality.¹¹ Further, there is now evidence for leaving behind a normal-looking appendix when a diagnostic laparoscopy is carried out for suspected

appendicitis, even if another diagnosis cannot be found.¹² This is supported by the fact that removal of a normal appendix is associated with considerable complications and costs.¹³

Our study shows a cohort of patients with a major intra-abdominal inflammatory process, who underwent an unnecessary appendectomy, and in > 50% of whom the cause of the inflammation was not found. In conclusion, we believe that our study supports the use of diagnostic modalities such as ultrasound scanning and laparoscopy in fertile women presenting with acute lower-abdominal pain.

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