Comparison of Abdominal Pain and Postoperative Complications for Histologically Inflamed and Non-Inflamed Appendix Following Laparoscopic Appendectomy

Kamal R. Aryal* and Raju Limbu
James Paget University Hospital, Great Yarmouth, UK

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*Corresponding author: Kamal Raj Aryal, James Paget University Hospital, Lowestoft Road, Great Yarmouth, NR31 6LA, Norfolk, UK; E-mail: rikamal2000@hotmail.com.

Abstract

Introduction: There is some debate on whether normal looking appendix should be removed when no other cause of right lower abdominal pain is found on laparoscopy. The aim of this study was to find whether post-operative complications, abdominal pain and hospital re-admission rate due to abdominal pain in histologically non-inflamed appendix patients are different from patients with histologically inflamed appendix.

Methods: Patients undergoing laparoscopic appendectomy from January 2014 to August 2015 in a UK Hospital were collected from theatre database. Structured telephone survey was carried out in January 2016 to all these patients to assess post-operative results including abdominal pain.

Results: 145 patients underwent laparoscopic appendectomy. Survey response rate was 81% (n = 118) including 73 (inflamed) and 45 (non-inflamed) appendix on histology. The visual analogue scale (VAS) for pain at the time of surgery was 0 in 95% (69/73) and 93% (42/45) in inflamed and non-inflamed groups respectively (p = 0.79). The mean VAS for four inflamed patients was six (SD 3.26) and for three non-inflamed patients was 5.7 (SD 3.05) (p = 0.44). The readmission rate was 4/73 and 2/45 respectively (p = 0.80). Post-operative wound infection rate was 8/73 and 3/45 respectively (p = 0.89).

Conclusions: Laparoscopic appendectomy for right lower abdominal pain for non-inflamed appendix removed, when no other cause of abdominal pain is found has similar results to removing inflamed appendix.

Keywords: Appendicitis; Laparoscopic; Appendectomy; Non-Inflamed appendix, Negative appendectomy

Introduction

Acute appendicitis has been reported to be the third most common cause of emergency general surgical admissions after abscesses and non-specific abdominal pain [1]. Appendectomy has been the treatment of this condition. With an open approach, the appendix is removed even when the appendix looks normal to avoid confusion in the future. With increasing use of laparoscopy both for diagnostic and therapeutic use whether normal looking appendix should be removed when no other cause of abdominal pain is found is still a contentious issue [2–5]. A Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) guideline suggests, in patients who have normal looking appendix on laparoscopy, when no cause of abdominal pain is found the appendix should be removed [6]. However, the level of evidence for such recommendation was poor (level III) backed by only one retrospective study [6]. A survey of American, French and Italian surgeons revealed that they would remove normal looking appendix when no other cause of abdominal pain is found [7]. There is no reported study looking at the postoperative complications and whether the pain disappears in patients with histologically non-inflamed appendix undergoing laparoscopic appendectomy.

All surgeons would agree that inflamed appendix would be removed on laparoscopy. Unfortunately, the laparoscopic appearance may not be 100% sensitive and specific when compared with histology. Substantial percentage of patients with normal looking appendix during laparoscopy with no other cause of abdominal pain is found to have inflamed appendix on histology.

The aim of this study was to find if there was any difference in abdominal pain, complications and re-admission rates in patients with histologically inflamed appendix compared with histologically non-inflamed appendix. Abdominal pain immediately after surgery can be associated with size and number of surgical wound. This survey compared patient’s abdominal pain well beyond immediate postoperative period (at least five months) when pain due to port site or incision have resolved to know whether appendectomy relieved patient’s symptoms or not.

Methods

Patients more than 10 years of age undergoing laparoscopic appendectomy as urgent/emergency from January 2014 to August 2015 over 18 months’ period were obtained from the theatre database. Patients with other cause to explain pain and did not undergo laparoscopic appendectomy have been excluded. Patients undergoing diagnostic laparoscopy in elective setting needing appendectomy have been excluded.

Details of these patients were obtained from the Hospital records including OR MIS. All operation notes and histology reports were reviewed. Following Research and Development (R & D) approval a patient questionnaire was sent to all patients with covering letter stating that they would receive telephone call within two weeks. These were sent in January 2016 to allow at least five months following laparoscopic appendectomy when postoperative pain due to port sites and wounds should have resolved. They were asked not to return the questionnaire by post. Telephone call was made using same pro forma as sent by post relating to their abdominal pain on visual analogue scale, any post-operative complications and readmissions (see patient questionnaire figure). Ethics committee approval was not deemed necessary by the R & D.

The standard practice about laparoscopic appendectomy in the author’s unit has been: Laparoscopy for suspected appendicitis supported by clinical, laboratory +/- radiology findings. Laparoscopic appendectomy if appendix found to be inflamed on laparoscopy.

When appendix is found to be normal macroscopically - if other cause is found to explain lower abdominal pain - leave
Survey of Lower Abdominal Pain after Laparoscopic Appendectomy

1. How is the pain following your operation?
   - Disappeared
   - Is better
   - Is the same
   - Is worse

2. If you are still in pain, please place a vertical mark on the scale below to indicate how bad you feel your pain is.
   - 0
   - No Pain
   - 10
   - Worst pain

3. Following your operation, did you have any complications?
   - None
   - Wound infection
   - Bleeding
   - Other, please specify:

4. Did you have further admissions to hospital with the same symptoms to those you had before you had your appendectomy?
   - Yes
   - No
   - If yes, how many admissions?
     - 1
     - 2
     - 3 or more

5. Did you visit your GP again with the same symptoms to those you had before you had your appendectomy?
   - Yes
   - No
   - If yes, how many visits?
     - 1
     - 2
     - 3 or more

Please state any further diagnosis and treatment received:

6. Please indicate on the scale below your overall satisfaction with the outcome of this operation.
   - 0
   - Lowest level
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - Highest level

Comments

Thank you for taking the time to complete this questionnaire.

Figure 1: Patient questionnaire form.
appendix behind. If no other cause is found, perform laparoscopic appendectomy. All procedures are performed by consultants or by registrars under supervision by a consultant. Port sites depend on surgeon’s preference but most use an umbilical 10mm, left iliac fossa 5 mm and suprapubic 5 mm ports. Prophylactic antibiotics were used in all patients and was continued as therapeutic if the appendix was gangrenous, perforated or pus present. Appendix was removed via umbilical port. It was surgeon’s preference whether to use endo bag to remove the appendix or not.

Surgeon’s assessment of appendix at laparoscopy on whether inflamed or not is based on established features of inflammation on vision for centuries such as redness (rubor), congestion and swelling (tumour), exudate, pus or necrosis [8]. All operating notes were reviewed to find this comment from the surgeon and grouped in to inflamed or non-inflamed on laparoscopy. The pathological findings of inflamed and non-inflamed were based on the pathologist’s histology report.

The assessment of patients with right lower abdominal pain included interpretation of clinical and laboratory findings. Selected patients underwent ultrasound or computerized tomography (CT) scan if deemed necessary. Ultrasound was easily available in author’s unit and was used judiciously particularly in young female patients for right lower abdominal pain. Indications of laparoscopy were convincing appendicitis from history, physical examination and laboratory findings; imaging diagnosis of appendicitis; or unresolved right lower abdominal pain with tenderness of more than 24 hours’ duration since admission to hospital. CT scan though has been shown to reduce negative appendectomy rate has risks of radiation and may not be easily available all times and in all Hospitals [9]. CT was performed selectively such as patients more than 50 years with right lower abdominal pain where caecal pathology needed to be ruled out.

The comparison with inflamed vs. non-inflamed group for above variables was carried out using chi square test for non-parametric data and students t-test for parametric data.

**Results**

Altogether 145 patients underwent laparoscopic appendectomy. Among 145 patients undergoing laparoscopic appendectomy, telephone survey response rate was 81% (n = 118), (male 53, female 65, age range 10 years - 72 years median age 23 years). Remaining patients could not be contacted by telephone. There were 73 (inflamed) and 45 (non-inflamed) appendix on histology. Thirty three percent of the patients with normal looking appendix on laparoscopy were found to have microscopic appendicitis (Table 1).

The VAS pain score was 0 in 95% (69/73) and 93% (42/45) in inflamed and non-inflamed groups respectively (p = 0.79). Among four patients in the inflamed group the average pain score was six, standard deviation (3.26) and among three patients in the normal histology group the pain score was 5.6 standard deviation 3.05 (p = 0.44). The readmission rate was 4/73 and 2/45 respectively. Post-operative wound infection rate was 7/73 and 4/45 respectively. There was one pelvic abscess in the inflamed group (table 2). Among 45 patients without inflammation on histology six had faecolith (live from laparoscopically inflamed and one from laparoscopically normal group).

**Discussion**

In this study, there was high rate (33%) of histologically inflamed appendix when it looked normal on laparoscopy which is similar to another study by Philips, et al (29%) but lower than study by Chiarugi, et al. (58%) [10,11]. It was interesting that many (28%) appendices when the surgeon thought was inflamed turned out to be non-inflamed on histology. In another study 3 of 17 (18%) patients who were thought to have inflamed appendix by the surgeon were found to have normal histology [12]. These findings tend to indicate it is difficult to relate laparoscopic macroscopic findings to pathologist’s microscopic findings. Surgeon’s perception of inflammation may vary from person to person and it may be difficult to be definite whether the appendix is inflamed or not particularly in those cases where the inflammation is only mild.

In this study, there was appendectomy for (45/118) = 38% appendectomy specimens for non-inflamed appendix which is higher than other large scale studies (from 5% up to 15%) [13]. But, difference with these studies is that we have included only laparoscopic appendectomy patients here unlike other studies which have included open appendectomy as well. In fact, it has been reported that there has been significant increase in negative appendectomy rate with increased use of laparoscopy over the years – while one study showed this increase from 15–22% [14]. Another study showed this increase from 9.1–21.2% [15]. When only laparoscopic appendectomy was included in another study the negative appendectomy rate was 40% (25 of 62 patients), similar to present study [16]. The use of laparoscopy as diagnostic means in some cases as work up for appendicitis may have attributed towards higher negative appendectomy rate as well.

If appendix is found to be inflamed on histology, the appendix should be removed. The comparison between histologically inflamed and non-inflamed groups using this survey provided an opportunity to test if there is any difference in the variables studied. From this study the complication rate, pain score and readmission rates were not higher in patients who had non-inflamed histology compared to those with inflamed histology in patients with suspected appendicitis undergoing laparoscopic appendectomy.

<table>
<thead>
<tr>
<th>Laparoscopy Finding</th>
<th>Histology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td>Not inflamed 21</td>
</tr>
<tr>
<td></td>
<td>Inflamed 12</td>
</tr>
<tr>
<td>Inflamed</td>
<td>Not inflamed 24</td>
</tr>
<tr>
<td></td>
<td>Inflamed 61</td>
</tr>
</tbody>
</table>

**Table 1**: Comparison of laparoscopy and histology findings.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Histology Inflamed (n = 73)</th>
<th>Histology Non-inflamed (n = 45)</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. readmitted to Hospital</td>
<td>(3 due to pain and one due to wound infection)</td>
<td>2 (all due to pain)</td>
<td>Chi-square test 0.062. p = 0.80</td>
</tr>
<tr>
<td>Pain disappeared completely to zero in</td>
<td>69</td>
<td>42</td>
<td>Chi-square test 0.070 p = 0.79</td>
</tr>
<tr>
<td>Pain scores in those where pain still present</td>
<td>10, 6, 6.2. (Mean 6)</td>
<td>9, 5, 3. (Mean 5.6)</td>
<td>t-test 0.1371. p = 0.44</td>
</tr>
<tr>
<td>No. of wound infections</td>
<td>7</td>
<td>4</td>
<td>Chi-square test 0.016 p = 0.89</td>
</tr>
</tbody>
</table>

**Table 2**: Comparison of inflamed and non-inflamed appendix patients.
Surgeons favor leaving behind normal looking appendix because removing normal appendix may cause unnecessary complications and abdominal pain may persist. As mentioned above, postoperative pain, re-admission rate and postoperative wound infection rate were not different between inflamed and non-inflamed appendix group. However, in non-inflamed appendix group which underwent appendectomy showed 8.9% (4/45) of wound infection and 4.4% (2/45) of re-admission rate. The first complication would not have happened if these appendices were not removed on the first instance. The re admission rate may still have happened for recurrent abdominal pain. The first complication would have been reduced by reducing the negative appendectomy rate. The wound infection rate of 8.9% seems high for the normal looking appendix group and is no different from the inflamed group. As mentioned in methods section all had prophylactic antibiotics but not all surgeons use endo bag to remove appendix. Endo bag use in all appendix removals reduces port site infection [17]. The unit has presented these results to surgeons locally and is re-auditing the negative appendectomy rate to reduce post-operative complications.

One point about faecolith needs clarification. Among 45 patients with no inflammation on histology 6 were found to have faecolith. Five of them appeared to be inflamed to the operating surgeon. Unfortunately, there is no way to detect laparoscopically whether the patient has faecolith or not. Although many believe faecolith may have caused pain or may cause appendicitis in the future if left back, one study has shown that 17 of 22 patients (77%) who were detected to have faecolith on radiology did not have any problems in the future when discharged home following acute admission [16]. Many may also argue that faecolith patients should have been grouped with inflamed group. When compared faecolith patients grouped together with inflamed patients in the present study and others as non-inflamed, there was no statistically significant difference either.

Similar complication rate between non-inflamed and inflamed patients in this study needs explanation. One reason for this may be relatively small sample size considering how common appendicitis is. Other reason may be selective removal of normal looking appendix only when no other cause of abdominal pain is found may have reduced the complication rate in non- inflamed appendix group. Third there may be expression of cytokines such as tumour necrosis alpha (TNF alpha) and interleukin-2 in many of these so called non-inflamed histology specimens which is detectable only by in situ hybridisation for mRNA expression which are not routinely measured on standard microscopy [17]. 23% of suspected appendicitis patients with normal histology were found to have expression of these cytokines in one study [17].

Although it may appear this is retrospective questionnaire for pain by telephone, as is clear from the figures and above the questions did not focus on pain immediately after the post-operative period but status of abdominal pain at least five months after the operation when pains related to operations should have disappeared.

This study has some limitations. First there is no power calculation and the number required to detect any difference may be very large. This however is a pragmatic study to look at if the patients with non-inflamed appendix have more risk of complications or have persistent pain on removing their appendix. We also do not have data on those patients where the cause of the abdominal pain was thought to be due to other causes and appendix was left behind. This study also does not tell us what may have happened if those appendices which looked normal were left behind either. The pathology of appendix specimen could have been more detailed e.g. acute, sub acute, chronic, focal or not, serosa, mucosa, muscle layer etc. Unfortunately, Pathologist’s report only mentions about inflamed or not; some cases with faecoliths have been enumerated above. Due to retrospective nature of the study it was not possible to look at these specifics of inflammation.

Laparoscopic appendectomy for histologically non-inflamed appendix when no other cause of pain is found during laparoscopy does not cause more complications and pain relief is similar when compared with histologically inflamed appendix.

**Conflict of Interest**

Authors declared that they have no conflict of interest.

**References**


*Corresponding author: Kamal Raj Aryal, James Paget University Hospital, Lowestoft Road, Great Yarmouth, NR31 6LA, Norfolk, UK; E-mail: rlkamal2000@hotmail.com

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