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Research Article

Laparoscopy in Appendicitis, in Assessing and Managing the Alternate Diagnosis

Padmakumar Ramakrishnapillai*[1], Madhukara Pai[1], Farish Shams[1], Mary Varghese[1], Anithadevi T Sathyan[2], Christeena Jose[2]

[1]Department of Laparoscopic and Metabolic Surgery, Sunrise Hospital, Kakkanad, Kochi: 682030, India

[2]Department of Biostatistics, Sunrise Hospital, Kakkanad, Kochi: 682030, India

***Corresponding author:** Padmakumar Ramakrishnapillai, Senior Consultant Laparoscopic &MetabolicSurgeon,Director – Minimally Invasive Surgery Institute International (MISII),Department of Laparoscopic and Metabolic Surgery, Sunrise Hospital, Seaport-AirportRoad, Kakkanad, Kochi 682030, India. Tel: +91-944-7230370; Fax: +91-484-2428917; E mail: drrpadmakumar@gmail.com

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Abstract

Background: Acute appendicitis is managed by open or laparoscopic surgery. Even though the clinical and radiological findings are suggestive of acute appendicitis, on exploration, the appendix may be normal. This study evaluates laparoscopy in assessing and managing the alternate diagnoses.

Methods: This is a retrospective study of 394 laparoscopic appendicectomies conducted at Sunrise Hospital, Kochi. The diagnosis was based on clinical or radiological evidence.

Results: The mean age was 21.87 years with male-female ratio 1.13:1. The diagnosis of acute appendicitis was correct in 313 (79.44%). Alternate diagnosis was the cause of pain in 58 (14.72%) and appendicectomywas negative in 23 (5.84%). Of the alternate diagnosis, the cause of pain could have been detected even with open appendicectomy in 31 (7.86%). But in 27 (6.85%) the diagnosis was possible only because of laparoscopy or else the incision should have been extended.

Conclusion: Laparoscopic appendicectomy helps in getting alternate diagnosis and managing them in those who would otherwise be considered as negative appendicectomy. Open appendicectomy-may not be able to achieve this advantage of laparoscopy. So laparoscopy should be considered as the ideal procedure for all suspected cases of acute appendicitis.

Keywords:

Laparoscopy; Appendicitis; Alternate diagnosis; Negative appendicectomy; Alvarado score

Introduction

Acute appendicitis was first described by Herbert Fitz in 1886 [1]. Since then it has been a challenge for the surgical community to diagnose the condition accurately. The accuracy in diagnosing acute appendicitis with clinical and radiological methods is approximately 80% [2]. On clinical grounds various scoring systems are used, of which Alvarado scoring system is the one, most commonly used. Alvarado score has 8 variables: migrating right lower abdominal pain, anorexia, nausea or vomiting, right lower quadrant tenderness, rebound tenderness, pyrexia, leukocystosis and neutrophilia. All findings have a score of "one" except right lower quadrant tenderness and leukocystosis, that has a score of "two". If the total score is 5 or more, the chance of it being appendicitis is high and if the score is 7 or more there is very high likelihood that it is appendicitis[3].Radiological features favoring appendicitis are thickened aperistaltic bowel loop in right iliac fossa (diameter>6mm), loculated or free fluid and inflammatory changes in right lower abdomen[4].

In the prelaparoscopic era, the need for an accurate preoperative diagnosis was absolutely necessary. If the appendix was found to be normal during surgery nothing much could be offered, through the incision made, for the disease the patient was suffering from. Diagnostic laparoscopy forms the first step of laparoscopic appendicectomy. It helps to detect the alternate diagnosis when the appendix is found to be normal[5]. This study aims at evaluating laparoscopy in assessing the alternate diagnosis and their management in cases of suspected acute appendicitis.

Materials and Methods

A retrospective study was conducted on 394 patients, who underwent laparoscopic appendicectomy during the period between January 2010 and December 2015 at Sunrise Hospital, Kochi, India. The diagnosis of acute appendicitis was made on clinical and radiological grounds. For clinical diagnosis Alvarado scoring system was used. USG abdomen was done for all and Computerized tomography (CT) abdomen was done when the diagnosis was not sure. Treatment plan was decided as per the flow chart (Figure1). Informed consent for surgery was obtained from all patients (Figure 2).

Operative procedure

Under general anesthesia, patients were prepped and draped. First entry was through umbilicus. Generally direct entry with a blunt 10-mm metallic trocar was performed. A vertical incision was used as it could be extended in cases of difficulty or at times of specimen retrieval. Patients were kept in head low position with right side up. Working ports were placed at right lumbar region (3-mmtrocar) and left iliac fossa (5-mmtrocar) under vision. Diagnostic laparoscopy was performed.

Appendix was held straight and meso appendix cauterized and divided. Base of appendix was located by shouldering effect while making it "sit on the caeccum and then it was secured with two extra-corporeal Roeders" knots with number 1 polyglactin suture. Appendicectomy was performed and specimen was retrieved through the 10-mm port. It is achieved by changing 10-mm scope to 5-mm scope and vision was provided via 5-mm trocar. Additional procedures were performed when felt necessary like mesenteric node biopsy; peritoneal lavage etc.10-mm port was closed with a 1-0 polypropylene suture. Oral feeds were started after 4 hours and patients were discharged within 24 hours. Patients were asked to follow up and collect biopsy report 10 days later.

Definitions

Suspected acute appendicitis: It is preoperative diagnosis of acute appendicitis in a patient with abdominal pain on the basis of Alvarado score, USG abdomen or CT abdomen.

Confirmed acute appendicitis: Histopathology showing transmuralneutrophilic infiltration confirms it as a case of acute appendicitis.

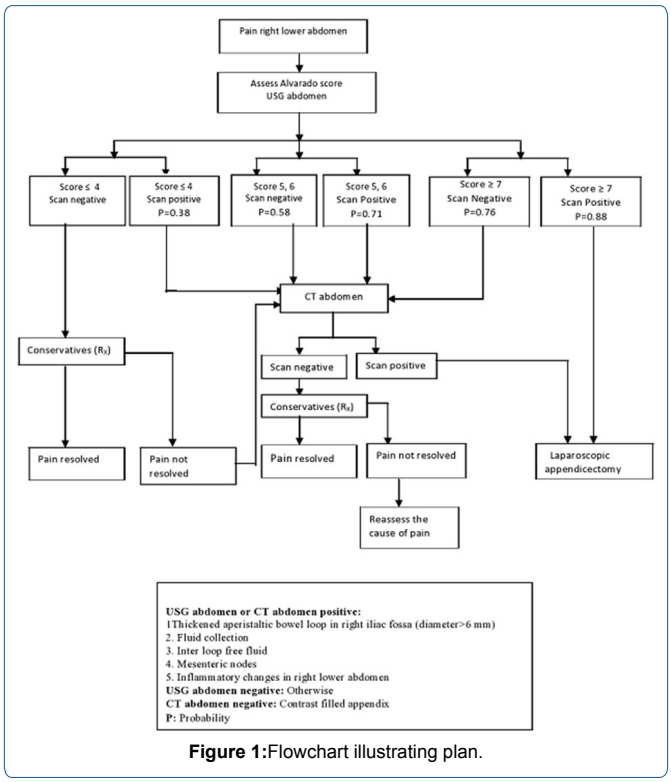


Figure 1: Flowchart illustrating plan.

Alternate diagnosis: It is a different pathology detected either during surgery or with histopathological assessment in a patient undergoing laparoscopic appendicectomy for suspected acute appendicitis. That pathology is confirmed as the cause of pain i.e. the patient was not having acute appendicitis.

Negative appendicectomy: Appendicectomydone in patients with suspectacute appendicitis is considered as negative, if during surgery no cause for pain is detected and histopathology is showing unremarkable appendix. Histopathologicaldiagnosis like chronic appendicitis, scarring of appendix, resolving appendicitis, mucosal neutrophilic infiltration, prominent lymphoid follicles, eosinophilic infiltration, normal appendix etc., were considered as unremarkable.

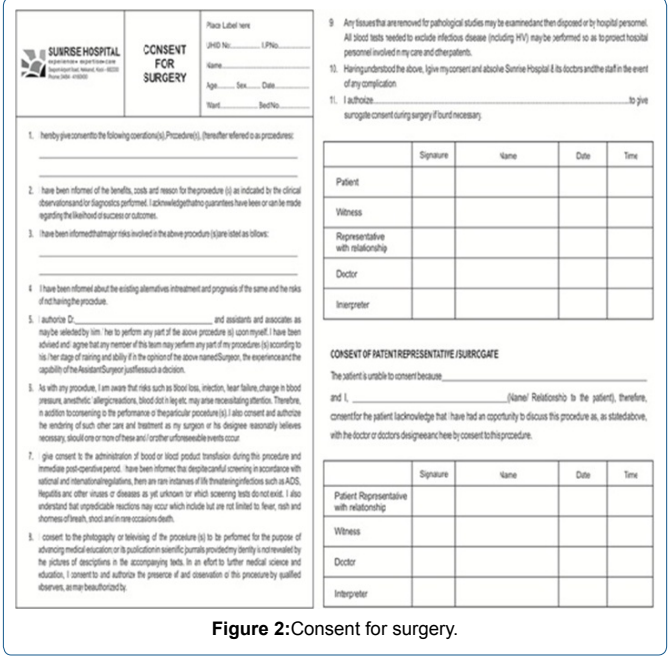
Incidental appendicectomy: It is appendicectomy done for cause other than suspected acute appendicitis. These include interval appendicectomy and appendicectomy for chronic appendicitis, ileocecal intussusceptions etc.

Inclusion and exclusion criteria

Inclusion criteria:

- Laparoscopic appendicectomy for suspected acute appendicitis.
- Procedures where ovarian cystectomy, cholecystectomy etc. were combined with laparoscopic appendicectomy, if appendicectomywas done for suspected acute appendicitis.

The exclusion criteria: Incidental appendicectomy.


SUNRISE HOSPITAL

CONSENT FOR SURGERY

Place Label here

UHID No:..... I.P.No.....

Name.....

Age..... Sex..... Date.....

Ward..... Bed No.....

1. hereby give consent to the following operations(s).Procedure(s), (hereafter referred o as procedures):

2. I have been informed of the benefits, zosts and reason for the procedure (s) as indicated by the clinical observations and/or diagnostics performed. I acknowledge that no guarantees have been or can be made regarding the likelihood of success or outcomes.

3. I have been informed that major risks involved in the above procedure (s)are listed as follows:

4. I have been informed about the existing alternatives in treatment and prognosis of the same and the risks of not having the procedure.

5. I authorize Dr._____ and assistants and associates as may be selected by him / her to perform any part of the above procedure (s) upon myself. I have been advised and agree that any member of this team may perform any part of my procedures (s) according to his / her stage of training and ability if in the opinion of the above named Surgeon, the experience and the capability of the Assistant Surgeon justifies such a decision.

6. As with any procedure, I am aware that risks such as blood loss, infection, tear failure, change in blood pressure, anesthetic/ allergic reactions, blood clot in leg etc. may arise necessitating attention. Therefore, in addition to consenting to the performance of the particular procedure (s), I also consent and authorize the rendering of such other care and treatment as my surgeon or his designee reasonably believes necessary, should one or more of these and / or other unforeseeable events occur.

7. I give consent to the administration of blood or blood product transfusion during this procedure and immediate post-operative period. I have been informed that despite careful screening in accordance with national and international regulations, there are rare instances of life threatening infections such as AIDS, Hepatitis and other viruses or diseases as yet unknown or which screening tests do not exist. I also understand that unpredictable reactions may occur which include but are not limited to fever, rash and shortness of breath, shock and in rare occasions death.

8. I consent to the photography or televising of the procedure (s) to be performed for the purpose of advancing medical education; or its publication in scientific journals provided my identity is not revealed by the pictures of descriptions in the accompanying texts. In an effort to further medical science and education, I consent to and authorize the presence of and observation of this procedure by qualified observers, as may be authorized by.

9. Any tissues that are removed for pathological studies may be examined and then disposed of by hospital personnel. All blood tests needed to exclude infectious disease (including HIV) may be performed so as to protect hospital personnel involved in my care and other patients.

10. Having understood the above, I give my consent and absolve Sunrise Hospital & its doctors and the staff in the event of any complication.

11. I authorize_____to give surrogate consent during surgery if found necessary.

	Signature	Name	Date	Time
Patient				
Witness				
Representative with relationship				
Doctor				
Interpreter				

CONSENT OF PATENT REPRESENTATIVE /SURROGATE

The patient is unable to consent because_____

and I, _____(Name/ Relationship to the patient), therefore, consent for the patient lack knowledge that I have had an opportunity to discuss this procedure as, as stated above, with the doctor or doctors designee and here by consent to this procedure.

	Signature	Name	Date	Time
Patient Representative with relationship				
Witness				
Doctor				
Interpreter				

Figure 2: Consent for surgery.

Statistical analysis

There were 394 patients who underwent laparoscopic appendicectomy for suspected acute appendicitis. Descriptive statistics were computed on variables such as age and gender in cases of confirmed acute appendicitis. Association of confirmed acute appendicitis with Alvarado score and USG abdomen were analyzed using Chi-square test ($p<0.05$). Correlation of confirmed acute appendicitis with Alvarado score, USG abdomen and CT abdomen was analyzed using Karl-Pearson correlation ($p<0.05$). Distribution of final diagnosis was displayed as a frequency table. Those patients who had an alternate diagnosis during surgery were analyzed: whether the diagnosis was possible without the help of laparoscopy. All statistical analyses were carried out using Statistical Package for Social Sciences (SPSS) version 19.1 and Microsoft Office Excel 2007.

Results

The study population consisted of 394 patients. The procedure was completed laparoscopically in 393 patients. In one patient, who was mentally retarded, the procedure was converted to open surgery due to lack of muscle relaxation. The patient was spastic even after relaxant administration.

In 357 (90.61 %) patients, laparoscopic appendicectomy alone was performed. In 36 (9.14%) patients, laparoscopic appendicectomywas combined with additional procedures like mesenteric node biopsy, Omental nodule excision, ovarian cystectomy, cholecystectomy, appendices epiploicae excision, Meckel'sdiverticulectomy etc. Histopathological confirmation was attained in 393 cases. In one case the laparoscopic findings were sigmoid perforation with pelvic peritonitis. Laparoscopic peritoneal lavage alone was performed and appendicectomy was not done as possibility of Crohn's disease was thought of. It was evaluated with a CT abdomen and anterior resection was performed laparoscopically after subsidence of sepsis.

The mean age of patients with confirmed acute appendicitis was 21.21±11.63, 168 males and 145 females (Table1). Statistical analysis has shown significant association of acute appendicitis with Alvarado score ($p<0.001$) and USG abdomen ($p=0.02$).

Diagnosis	n	Age (Mean ± SD)	Range in years	Gender	
				Male, f (%)	Female, f (%)
Acute appendicitis	313	21.21±11.63	Mar-72	168 (53.68)	145 (46.32)
Alternate diagnosis	58	20.44±13.62	Feb-71	22 (37.94)	36 (62.06)
Negative appendicectomy	23	23.97±15.47	Jun-72	9 (39.13)	14 (60.87)

Table 1: Diagnostic distribution of age and gender.

The sensitivity of Alvarado score (cut off point 5) was 97.44% with a specificity of 8.64%. The sensitivity of USG abdomen was 78.59% with a specificity of 33.33%. Gender specific assessment shows sensitivity and specificity were higher in males than in females (Table 2). Pooling of radiological assessment and Alvarado score had significant association ($p>0.001$) with a sensitivity of 63.78% and a specificity of 65.82%.

The association of CT abdomen and confirmed acute appendicitis was not significant ($p>0.05$). Correlations between histopathology and Alvarado score ($r=0.236$, $p<0.001$) and histopathology and USG abdomen ($r=0.176$, $p<0.001$) were found to be less. The correlation between CT abdomen and histopathology was not significant ($r=.090$, $p=0.667$).

In 313 (79.44%) patients, histopathology report showed acute appendicitis. 58 (14.72%) patients had alternate diagnosis and 23 (5.84%) had negative appendicectomy. Of the 58 patients with alternate diagnosis, the diagnosis could have been detected even with a classical open appendicectomy in 31 (7.86 % of the total) patients. But in 27 (6.85 % of the total) patients, the diagnosis was possible only because of diagnostic laparoscopy (Table 3).

Discussion

A group of 313 people with acute appendicitis were studied for age, male to female ratio and seasonal changes. Peak incidence of acute appendicitis was noted in the age group of 10-20 years which is in accordance with other studies. Male to female ratio is 1.1:1. It shows that appendicitis is more common in males than in females. World data shows the ratio as 1.4:1 [5]. Most Indian data show a female preponderance but it may be due to inclusion of negative appendicectomy that is more common in females. Only few studies show age, gender and seasonal assessment of confirmed acute appendicitis rather than entire study population [4-6] and these show male predominance.

Clinical Assessment	Alvarado score (cut off point 5) (Males, Females)	Alvarado score (cut off point 7)	USG (Males, Females)	USG+ Alvarado score (cut off point 5)
Sensitivity	97.44 % (98.81%, 95.86 %)	80.95%	78.59 % (80.36%,76.55%)	63.78%
Specificity	8.64 % (16.13%, 2.00 %)	39.24%	33.33% (32.26%, 34.00%)	65.82%
Positive predictive value	80.47% (86.46%, 73.94 %)	84.16%	82.00 % (86.54%, 77.08%)	88.05%
Negative predictive value	46.67 % (71.43%, 14.29%)	34.07%	28.72% (23.26%, 33.33%)	31.52%
P-Value	0.010(<0.001,0.48)	<0.001	0.02 (0.11, 0.14)	<0.001

Table 2: Association of final diagnosis with clinical assessment.

As in other studies, Alvarado score was seen as a better marker of acute appendicitis. It had high sensitivity when action point was ≥5 and more specific when action point was ≥7 [3]. It is a better indicator in males than in females [7]. It is a better tool in the emergency room, so that the patient with score ≥5 can be shown to the surgeon immediately. But even when the score is more than 7 it has a specificity of 39.24% only. So it cannot be solely relied up on as a specific marker for planning surgery. When combined with USG abdomen, specificity increases to 65.82% with apositive predictive value of 88.05%. In suspicious cases, Alvarado score 5 or 6 or USG abdomen negative, we can get the help of CT abdomen, making the workup cost-effective. The association between CT abdomen and confirmed acute appendicitis was not significant in our study. This is probably because CT abdomen was not done for the entire study population. Studies in which CT abdomen was done for entire population show that it has better sensitivity and specificity, but has the demerits of radiation exposure and increased cost [4-8].

As per our institution protocol; we do not manage suspected acute appendicitis conservatively. So it was not possible to assess the perforation rate which increases with conservative treatment to reduce negative appendicectomy rates[9,10].

The rate of negative appendicectomywas reduced with laparoscopy as it aids in diagnosing the cause of pain. Negative appendicectomy in our study is 5.84% and combined with alternate diagnosis it is 20.56%. Most studies show negative appendicectomy rates of 8-30% [4].

In 27 patients, (47% of alternate diagnosis, 6.9% of total population) the diagnosis was possible only with diagnostic laparoscopy. Or else the incision had to be extended or a laparotomy incision had to be made to get the diagnosis and tackle it. This is the advantage of laparoscopic appendicectomy. The first step of the laparoscopic surgery being diagnostic laparoscopy i.e. examination of the entire peritoneal cavity which is not possible with classical open appendicectomy; we can detect the pathology accurately [5-11]. Other advantages of laparoscopic appendicectomy are,

1. Cosmetic:- Only a 3-mm scar in right hypochondrium that mimics a mole, 10-mm scar goes in the depth of umbilicus and left iliac fossa 5-mm scar is covered with undergarments [11]
2. Lesser pain, lesser hospital stay and lesser postoperative medications as the incision is smalland no muscle retraction is made [5, 11, 12]

Final diagnosis	Frequency (%)
Acute appendicitis	313 (79.44)
Alternate diagnosis	58 (14.72)
Can be detected with open appendicectomy also	31 (7.86)
Mesenteric adenitis, f (%)	26 (6.59)
Carcinoid appendix, f (%)	1 (0.25)
Acute omentitis, f (%)	1 (0.25)
Regional ilietis, f (%)	1 (0.25)
Meckel's diverticulitis, f (%)	1 (0.25)
Carcinoma Cecum, f (%)	1 (0.25)
Can be detected only with laparoscopy	27 (6.85)
Cholecystitis, f (%)	1 (0.25)
Gangrenous appendices epiploicae, f (%)	4 (1.01)
Infected retroperitoneal cyst, f (%)	1 (0.25)
Omental nodule, f (%)	1 (0.25)
Sigmoid diverticulitis with pelvic peritonitis, f (%)	1 (0.25)
Gynecological diseases	19 (4.83)
Endometriosis, f (%)	7 (1.77)
Ovarian cyst torsion, f (%)	3 (0.76)
Dermoid cyst, f (%)	1 (0.25)
Pelvic inflammatory disease, f (%)	5 (1.26)
Mittleschmerz, f (%)	1 (0.25)
Hemorrhagic ovarian cyst, f (%)	2 (0.50)
Negative appendicectomy, f (%)	23 (5.84)

Table 3: Distribution of final diagnosis.

3. Complication rates are comparable [5, 11, 12, 13]

In this study we have no mortality (0%) and conversion rate to open appendicectomy is 0.25%. Same one patient (0.25%) that was converted to open appendicectomy, developed intra-abdominal abscess 6 months later; that required drainage. Another one patient (0.25%) had immediate postoperative intestinal obstruction and required re-laparoscopy and adhesiolysis. No other morbidity was observed in this study group.

4. Additional procedures can be combined. We have combined cholecystectomy, fibroid removal, ovarian cystectomy, and adhesiolysis along with laparoscopic appendicectomy for acute appendicitis.

Thus we conclude that, in twenty percent of suspected cases of appendicitis even combined clinical and radiological

assessments are inaccurate. Laparoscopic appendicectomy helps in getting the alternate diagnosis in those who would otherwise be considered as cases of negative appendicectomy. It also helps in managing those cases who would otherwise continue to be in pain due to the alternate cause of pain. Open surgery may not be able to achieve these advantages of laparoscopy. So laparoscopy should be considered as the ideal procedure for all suspected cases of acute appendicitis.

Acknowledgement

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Ethical statement

Informed consent for procedure was obtained from all patients before surgery. It has been mentioned in the informed consent that the data of the procedure performed on the patient may be used for research purpose. As the procedures are well established once, no separate ethical clearance was obtained for procedure.

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