Have we lost the importance of clinical skills in diagnosing acute appendicitis?

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Abstract

Background: Negative appendectomy rates have always been a concern for surgeons. Acute Appendicitis is the most common emergent abdominal surgery worldwide. Diagnosis is based on clinical assessment, laboratory reports, radiological investigations and appendectomy is the treatment of choice. Removing a normal appendix is a relatively common surgical issue, defined as a negative appendectomy. Are we losing the clinical craft of bedside examination and history taking? Our aim was to estimate the negative appendectomy rate from the year 2011 to 2016 in King Fahad Hospital, Tabuk, Saudi Arabia.

Methods: This retrospective study was performed in a 100 bedded secondary care adult teaching hospital with approximately. 35,000 annual emergency department visits. The authors used the medical records to examine the patients suspected of having appendicitis who presented to the emergency department between 2011 and 2016. Medical records (detailed clinical, laboratory, Ultrasonography of the abdomen, wherever applicable), operative surgery data and pathology reports were reviewed to determine the negative appendectomy rate (NAR).

Results: Out of 831 cases of acute appendicitis, 781(94%) cases were proven histo-pathologically as acute appendicitis and remaining 50 (6%) were considered as negative appendectomies.

Conclusion: A good initial clinical examination and serial clinical examination in doubtful cases is the cornerstone for diagnosis and management of appendicitis. If clinical examination is done with basic investigation alone, negative appendectomy rates can be brought down.

Keywords: Appendicitis; Ultrasonography; Histopathology; Neutrophilia; Appendectomy

Introduction

For many years, it has been accepted that there is an inherent error rate of around 5-15% in the diagnosis of appendicitis. Improved diagnostic methods have not substantially altered this rate of error[1,2]. It had been usual in surgical practice all over the world to accept a negative appendectomy rate (even up to 30%)[3]. Indeed, it has often been stated that if a surgeon does not have a negative appendectomy rate of 10%, he is said to have been operating on too few patients, thereby exposing some of them to the increased risk of the complications of rupture. Until now, this thesis has never been put to test. However, in most cases, the patient with a negative appendectomy is defined to be one where the diagnosis was doubtful preoperatively due to equivocal physical findings. An operation is advised to settle the diagnosis on the assumption that the hazard of missing appendicitis is greater than that of an unnecessary abdominal exploration. Although a "negative" appendectomy carries very little mortality risk, the postoperative morbidity is not inconsequential. Several days in the hospital are required at minimum. There is a measurable incidence of wound infections and other complications of laparotomy. We have sought to determine what our negative appendectomy rate was and whether our clinical judgment still persists in this era of highly sophisticated investigations.

Materials and methods

This retrospective institutional review board approved study was performed in a 100 bedded secondary care

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adult teaching hospital with approximately 35,000 annual emergency department visits. The authors obtained a waiver of informed consent and used the medical records system to examine the patients suspected of having appendicitis who presented to the emergency department between 2011 and 2016; this was the period when CT was not commonly used at our hospital for the evaluation of appendicitis. Medical records (detailed clinical, laboratory, Ultrasonography of the abdomen, wherever applicable), operative surgery data and pathology reports were reviewed to determine the negative appendectomy rate (NAR). Due to the lack of manpower and administrative holdup, diagnostic laparoscopy for acute appendicitis was not allowed in both out of hours as well during day-shifts.

Definitions:

Appendicitis was defined for the main study as the presence of inflammatory cells (polymorphonuclear leucocytes, lymphocytes or plasma cells) in the appendix. The absence of inflammatory cells on histopathology was considered a negative appendectomy.

Patients were selected for admission if they had a clinical course consistent with:

1. Acute appendicitis: Classical presentation like pain abdomen, especially in Right Iliac fossa (RIF), shifting of pain from central abdomen to RIF, tenderness of RIF with rebound phenomenon, Rovsing's sign positive/Psoas stretch positive/ Obturator test positive and supported by laboratory findings.
2. Suspected acute appendicitis (like pain abdomen, pain right lower quadrant or lower abdomen), but the diagnosis was highly suspicious without laboratory or radiological evidence,
3. Suspected cases that were confirmed by USG abdomen of having acute appendicitis.
4. Suspected cases that lacked confirmatory physical findings and also lacked supporting laboratory and radiological evidence. Such cases were admitted to the hospital with appendicitis as a primary diagnostic concern and all were observed for a period of time, usually overnight, sometimes for 1-2 days.

If during the period of observation, symptoms progressed and peritoneal signs developed, appendectomy was carried out. Conversely, if symptoms subsided or another diagnosis was established, the operation was not performed. Those individuals who showed neither signs of improvement nor of deterioration and repeated investigations failed to establish the diagnosis were subjected to laparotomy by RIF incision. Those patients who required CT scans for establishing the diagnosis were not included in the study due to the inconsistency of the number of patients getting CT scans for diagnosis. The diagnosis of acute appendicitis was made instantaneously if the appendix was found inflamed or if it was covered with adherent omentum, pus, free fluid, perforation of the appendix or if it was not possible to see the appendix because of inflammatory adhesions, abscess or oedema in the peri-caecal region. If the appendix was seen and judged to be normal, examination of the pelvic organs and small bowel were carried out in search of any other explanation for the physical findings. Appendectomy was carried out in both inflamed and visibly non-inflamed appendix to remove the diagnostic confusion later on. If a nonsurgical diagnosis was established, or the examination was negative, still appendectomy was performed to remove the future diagnostic confusion and appendix was sent for pathological examinations for further confirmation and the patient was discharged from the hospital after recovery.

Results

A total of 831 cases of appendectomies were studied from 2011 to 2016, after excluding patients not meeting the criteria for acute appendicitis and in whom surgery was not performed. Out of 831 cases of acute appendicitis, 781 (94%) cases were proven histo-pathologically as acute appendicitis and remaining 50 (6%) were considered as negative appendectomies. 680 patients were male, which is approximately 82%, while 151(18%) were female patients. Among all, 197 (24%) patients were between 5-15 years of age, 436 (52.5%) were between 16-30 years, 177 (21%) were between 31-45 years and 21 (2.5%) were 45 or more years of age. 482 (58%) patients had leucocytosis and 467 (56%) patients had neutrophilia. Selective ultrasonography (USG) of abdomen and pelvis were done for males and compulsory USG were done for female patients. Overall, 765 patients had undergone USG and out of which 457 (59.7%) had positive results of appendicitis on USG. Histopathological (HPE) reports of all the appendectomies performed was done which showed that, out of 831 patients who had undergone appendix removal, 781 (94%) had uncomplicated or complicated appendicitis and only 50 out of 831 had negative appendectomies rate (NAR), which approximates to 6%, with NAR being 4.4% in

males (29/680) and 14% in females (21/151). Among positive HPE reports, there were 70 gangrenous appendix cases, 38 lymphoid hyperplasia cases, 19 fecolith cases, abscess in 3 patients with autolysed appendix, mucocele of appendix in 2 patients and inflamed Meckel's diverticulum (MD) in 6 patients. Among the 6 MD patients, 2 were gangrenous MD, one attached to lateral abdominal wall in RIF, another to umbilical cicatrix (in both the cases, appendix was normal). Among other interesting pathologies, noted were lipomatosis and fibrosis of appendix, Neuroendocrine tumour (Carcinoid tumour) of distal appendix of less than 0.5 cm grade I, normal appendix with peri-appendicular inflammation, mucosal lymphoid hyperplasia, acute early appendicitis with suppurative peri-appendicular fibrous obliteration, necrosis of Meckels Diverticulum (MD) with normal appendix, MD with reactive lymphoid hyperplasia of appendix, chronic inflammation suggestive of Crohn's disease, Follicular lymphoid hyperplasia with a heavy enterobius vermicularis infestation and normal MD with appendicitis. Regarding the symptomatology and clinical features, 81% of patients had anorexia (674/831), 74% of patients had nausea (613/831), only 20% of patients had associated vomiting (167/831), 12.3% of patients had a fever of mild to moderate degree (103/831). Furthermore, 97% had tenderness of RIF (807/831), patients having rebound tenderness were 88% (735) and 34.7% had positive Rovsing's sign (289).

The results were noted down in the following tables 1 to 4.

Table 1. Gender-wise distribution

	Number	%
Total Appendicectomies done	831	100
Male	680	82
Female	151	18

Table 2. Age-wise distribution

Age in years	Number of Appendectomies	Percentage (%)
5-15 yrs	197	24
16-30 yrs	436	52.5
31-45 yrs	177	21
45+ yrs	21	2.5

Table 3. Signs and symptoms in appendectomy cases

Signs and symptoms	Present	Absent	Percentage (%)
Anorexia	674	157	81
Nausea	613	218	74
Vomiting	167	664	20
Fever	103	728	12.3
Tenderness RIF	807	24	97
Rebound Tenderness	735	96	88
Rovsing's Sign	289	542	34.7

Table 4. Laboratory investigations in appendectomy cases

	Result		Number	Percentage (%)
Leucocytosis	Positive		482	58
	Negative		349	42
Neutrophilia	Positive		467	56
Radiology (USG Abdomen-Pelvis)	765	Positive	457	60
		Negative	308	40
Histopathological examination (HPE)	Positive		781	94
	Negative		50	6
	Male		29	4.2
	Female		21	14
Special HPE findings	Perforated appendix		91	11
	Gangrenous		70	9
	Fecolith		19	2
	Lymphoid hyperplasia		38	5
	Appendicular Mucocele		2	0.2
	Meckel's Diverticulum		6	0.7

Discussion

The Appendicitis is the most common emergent surgical operation worldwide, account for 7% lifetime risk. Nowadays, it is starting to increase in incidence in developing countries; an appendectomy is the treatment of choice[4,5,6]. While appendicitis is uncommon in young children, it poses special difficulties in this age group. Young children are unable to relate history, often have abdominal pain from other causes and may have more nonspecific signs and symptoms. These factors contribute to a perforation rate as high as 50 percent in this group. In pregnancy, the location of the appendix begins to shift significantly by the fourth to fifth months of gestation. Common symptoms of pregnancy may mimic appendicitis, and the leucocytosis of pregnancy renders the WBC count less useful. While the maternal mortality rate is low, the overall foetal mortality rate is 2 to 8.5 percent, rising to as high as 35 percent in perforation with generalized peritonitis. As in non-pregnant patients, appendectomy is the standard for treatment. Elderly patients have the highest mortality rates. The usual signs and symptoms of appendicitis may be diminished, atypical or absent in the elderly, which leads to a higher rate of perforation. More frequent perforations combined with a higher incidence of other medical problems and less reserve to fight infections contribute to a mortality rate of up to 5 percent or more.

Distinguishing appendicitis from other causes of abdominal pain is challenging as most of the patients are children or young adults,who cannot articulate how they feel or where the pain is. There is also a wide variation in presenting symptoms and it is often hard to elicit the classical presentation. The use of symptoms and signs to identify who is at risk of acute appendicitisis particularly appealing as diagnostic imaging using a CT scan exposes patients to ionizing radiation along with unavailability of CT scans all the time and the diagnostic accuracy of USG scan is still uncertain with many limitations such as operator dependent. Initially, it was hoped that the increased use of ultrasonography might correlate with a decrease in the NAR.[7,8] Despite initial expectations, a study conducted from 1990 to 1994 found no association between the NAR and the use of USG.[9]

A study done by Ali S Raja, et al showed a significant decrease in the NAR and number of appendectomies per year. This decrease in the NAR was associated with a significant increase in the proportion of emergency department appendectomy patients who underwent preoperative CT.[10] There were a number of limitations to the study, especially that it was performed at a single academic medical centre and did not perform a cost-effectiveness analysis to estimate the value of the reduced NAR against the cost of CT and the associated potential long-term risks of radiation exposure. Important information which was not mentioned by them was about the timing of CT scan. Did all the patients of suspected appendicitis undergo CT scanning after a period of observation and was that period of observation fixed or variable? The authors concluded that additional studies were needed to assess the relative benefits of decreased NAR compared with the costs of CT and the risks of radiation exposure to help define the appropriate use of CT in the setting of suspected appendicitis. Sodickson, Aaron et al estimated cumulative radiation exposure and lifetime attributable risk (LAR) of radiation induced cancer form computed tomographic (CT) scanning of adult patients. The study identified a subgroup of patients who underwent large amounts of recurrent CT imaging and potentially high radiation-induced cancer risks. They concluded that the incremental risk was essentially the same from the firstor the 50th CT scan (aside from effects of different exposure ages) and the risk should be viewed as part of the patient's past (and predicted future) cumulative exposure.[11]

A study conducted by Emily M. Webbet al showed a fall in NAR in females from 29.8% to 1.6% and in male patients it decreased from 15.5% to 1.8%. Although other imaging modalities (the USG and magnetic resonance [MR] imaging) were occasionally used pre operatively, the use was too infrequent to be included in the study. The study found that most previous studies had suggested that CT was efficacious only in decreasing the negative appendectomy rate among women; their study showed that adult men benefit from CT as well. They showed that NAR was 4.7% for those who underwent preoperative CT compared with 12.8% for the patients who did not undergo preoperative imaging. Both male and female patient showed fall in NAR.[12]

A study done by Richard G et al suggested the highest NAR for children younger than 5 years and girls older than 10 years which can be reduced through the use of advanced diagnostic imaging. The routine use of CT and ultrasound should be limited in boys older than5 years with suspected appendicitis.[13]

A consistent decline in NAR was attributed to better gynaecological diagnostics resulting in a better pickup rate of ovarian causes misdiagnosed previously as

appendicitis in women by Seetahal SA et al.[14]

There are various scoring techniques like ALVARADO and RIPSA. Although the parameters are clinical and biochemical,scores are calculated for patients who presented with RIF pain. ALVARADO score contained 8 parameters whereas RIPASA score contained 18 parameters. The score for the parameters ranged from 0.5 to 2 for RIPASA and 1 to 2 for ALVARADO. A score of 7 for the ALVARADO scoring system and a score of 7.5 for RIPASA scoring system are taken as a high probability of acute appendicitis. There are various studies suggesting RIPASA score isabetter diagnostic scoring system for acute appendicitis compared to the ALVARADO score in a particular population.[15,16,17]

Another study by A.A. Malik et al suggested ALVARADO score as helpful in diagnosing acute appendicitis but its high false positive rates,especially in females,made it a less likely choice for reducing NAR. They suggested high false positive results for Acute Appendicitis (AA) in female patients by ALVARADO score but high scores in men and children were found in the early diagnosis of acute appendicitis.[18]

A recent review found that "fever" in a child is the single most important sign associated with appendicitis followed by rebound tenderness and migration of pain, suggesting that the Alvarado score may not be the most appropriate scoring system for children as double points are scored for tenderness in the right lower quadrant and leucocytosis, but only one point for each of all other signs (Figure 1).[19]

A study done by Lucian et al suggested Laparoscopy as an aid used to diagnose AA in suspected patients, especially when clinical findings were equivocal and insufficient to establish the diagnosis. Laparoscopy was proven cost-effective with the benefit of conversion to laparotomy at any time if required and reduced postoperative pain with early return to work made Laparoscopy as a beneficial tool in the management of suspected AA. With careful attention to patient selection, laparoscopy has the potential to reduce the negative appendectomy rate without increasing the risk to the patient. Further evaluation of its role in the management of these patients was suggested.[20]

A Dutch study suggested similar outcomes if imaging is included as a part of the diagnosis. 127 appendectomies were performed, showing appendicitis in 112 patients (88%); 15 appendectomies (12%) were negative. In the latter group, 12 were performed after false-positive imaging results, and 3 following inconclusive imaging results. The authors concluded that by using imaging in the diagnosis of appendicitis, the percentage of negative appendectomies remains close to the percentage declared as unacceptable.[21]

In another study it was suggested although NAR is reduced by preoperative imaging diagnosis of appendicitis, it should still mainly be based on history, clinical and laboratory data. Only the development of fast, inexpensive, accurate and non-ionizing radiation imaging modality will influence negative appendectomy rates in a significant way.[22]

A study published in The Royal College of Surgeons England by JG Mariadason suggested the NAR as a flawed quality metric that depends on the definition of 'acute appendicitis' and 'negative appendectomy'. CT reduces the NAR but routine CT was suggested as unnecessary to maintain a NAR below 3% and a positive Alvarado score was sufficient for male patients. The study stated that the ALVARADO score is a valuable tool in diagnosing appendicitis and overuse of CT could contribute to unnecessary surgery. An algorithm given below combining ALVARADO score with selective use of CT was suggested.[23]

Another study suggested that the ALVARADO score accurately predicts appendicitis and is well calibrated in men. As a decision rule for observation/admission, the ALVARADO score performs well as a 'rule out' criterion (high sensitivity). As a decision rule in relation to surgery, the ALVARADO score cannot be used to 'rule in' a diagnosis of appendicitis without surgical assessment and further diagnostic testing.[24]

Open appendectomy is a well-established and safe procedure for the treatment of acute appendicitis. A critical review of randomized controlled trials did not establish any conclusive results between open/ laparoscopic approach. The rate of complications was similar. Slim et al.[25] found the most common complication in open appendectomy was wound infection, while the most common complication of the laparoscopic procedure was intra-abdominal abscess. Some studies have found a trend toward increased intra-abdominal infection in the laparoscopic group[26,27].

Conclusions:

A careful, systematic examination of the abdomen is essential. While right lower quadrant tenderness to palpation is the most important physical examination finding, other signs may help confirm the diagnosis. The rebound tenderness that is associated with peritoneal irritation has been shown to be more accurately

identified by the percussion of the abdomen than by palpation with a quick release. Prompt diagnosis of appendicitis ensures timely treatment and prevents complications. Obvious cases of appendicitis require urgent surgical intervention, while equivocal cases warrant further evaluation and, serial bedside clinical examination. A good initial clinical examination and serial clinical examination in doubtful cases is the cornerstone for diagnosis and management of appendicitis. We did not use any analgesics but sometimes it may be necessary to appreciate the clinical signs better. The study did show that if clinical examination was done with basic investigation alone, negative appendectomy rates can be brought down. Also patient will avoid the large doses of radiation in the form of CT scanning or in the settings where there is no CT scanning available. In our opinion,the scoring system is again the same clinical examinations, but it can be deceiving. By doing a good clinical examination, we keep on improving our skills and pickup rates. If we keep on increasing our reliance upon investigations, we soon will lose this art of clinical examination and appreciating the most subtle signs of diseases. The best way to improve the skills is repeated practice like Logan Clendening said: "Clinical diagnosis is an art and the mastery of art has no end; you can always be a better diagnostician".

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