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Review Article

Role of Imaging in Reducing Negative Appendicetomy ?

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1. Abstract

1.1. Background

Surgery for pain in the right lower quadrant of the abdomen remains a clinical dilemma. Right iliac fossa pain is one of the most common causes of abdominal pain in young adults and children in the UK.Acute appendicitis is conventionally a clinical diagnosis; typical symptoms and laboratory may be absent in 20-33% of patients and, when they are present, can be similar to other conditions, especially in early stage and the diagnosis can be especially difficult in children, elderly patients, pregnant and childbearing age women. The challenge of acute appendicitis diagnosis is the atypical presentation, variation of presenting complaint severity and subjective factors as the description of pain course and nature. However, (80%) of diagnosing Acute Appendicitis depends on clinical assessment [1]. Patients with atypical symptoms and signs can be admitted to hospital for a period of observation, laboratory tests and medical imaging that may end up in a diagnostic laparoscopy and this approach can be associated with its own morbidity and financial costs. Imaging is key in optimizing outcomes in appendicitis, not only as an aid in early diagnosis, but potentially reducing negative appendectomy rates. In patients with suspected appendicitis a tailored approach is recommended, depending on disease probability, sex and age of the patient.Historically, the acceptable negative appendicetomy rate has varied depending upon patient age and gender and availability of imaging.

Many diseases resemble acute appendicitis presentations. Consequently, more effort would be directed toward reducing negative appendicetomy rate and its complications [2].

1.2. Aim

Diagnostic evaluation of imaging in patient with suspected appendicitis

1.3. Methods

This is a retrospective audit of patients who presented to the emergency department or refereed by GP, between May 2018 to April 2019, the clinical diagnosis was established by a surgical team on call. Management, Including discharge home, laboratory tests, Imaging, admission for observation, and operation was based on the surgeon's clinical assessment and decision.

Inclusion criteria were all patients referred to on call surgical team with suspected appendicitis Exclusion criteria were urological /Gynaecological

1.4. Results

273 underwent Appendicetomy (**Figure 1**); 127 patients with equivocal presentations had inpatient CT and/or ultrasonography scans. (**Table 1**) 72 (56.69%) females and 55 (43.30%) males ratio 1: 1.3 Age range from 8 to 90 mean age 42.34 years (**Table 2**) 99 scans accurately diagnosed acute appendicitis consistent with Histology (**Figure 2**, **Table 3**). Hence, the sensitivity of medical imaging was 96% however, there were four false-negatives (2 ultrasonography scans and 2 CT scan; 3.14%) These patients were admitted for observation (Based on clinical assessment) and were all eventually operated on to remove the appendix.

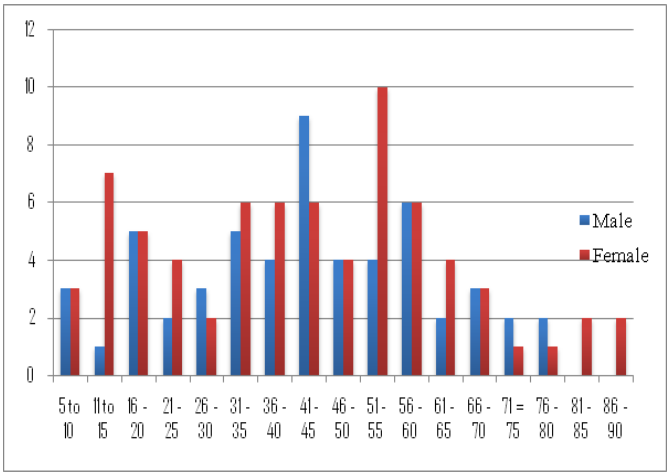

Figure 1: Demographics

Table 1: Imaging

Age	Gender		CT								US			Other/CT KU
	Male	Female	Appendi	Perforate	Mild Info	Normal	Not visu	Tumour	Crohns	Difficult	Appendi	Not Appendi	Not Visualise	Post op/Ren
5to10	3	3	0	0	0	0	0	0	0	0	3	3	0	0
11to15	1	7	2	0	0	0	0	0	0	0	5	1	0	2
16-20	5	5	6	0	1	0	0	0	0	0	2	1	0	1
21-15	2	4	3	0	0	0	0	0	0	0	1	1	1	0
26-30	3	2	2	1	0	1	0	0	0	0	1	0	0	1
31-35	5	6	6	1	0	0	0	0	0	0	4	0	0	0
36-40	4	6	7	2	0	0	0	0	0	0	1	0	0	1
41-45	9	6	11	0	1	0	1	0	1	0	0	1	0	0
46-50	4	4	8	0	0	0	0	0	0	0	0	0	0	0
51-55	4	10	11	2	0	1	0	0	0	0	0	0	0	0
56-60	6	6	9	3	0	0	0	0	0	0	0	0	0	0
61-65	2	4	4	2	0	0	0	0	0	0	0	0	0	0
66-70	3	3	5	0	0	0	0	1	0	0	0	0	0	0
71-15	2	1	2	0	0	0	0	0	0	1	0	0	0	0
76-80	2	1	3	0	0	0	0	0	0	0	0	0	0	0
81-85	0	2	1	1	0	0	0	0	0	0	0	0	0	0
86-90	0	2	2	0	0	0	0	0	0	0	0	0	0	0
	55	72	82	12	2	2	1	1	1	1	17	7	1	5

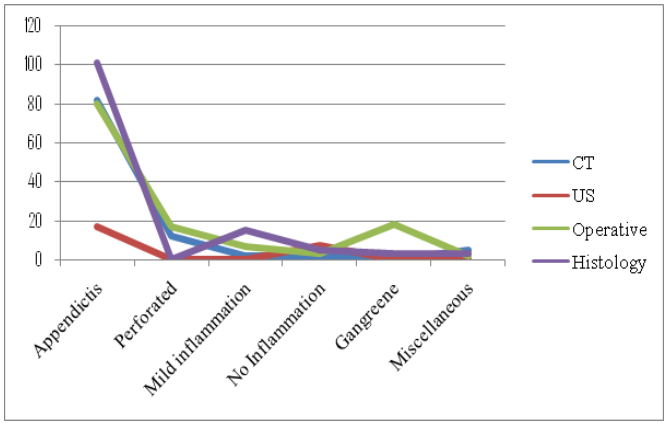

Figure 2: Radiology + Histology + Operative Findings

Table 2: Demographics

Total 273 patients operated for Ac. Appendicitis	
Radiology	127 Patients
Male: Female ratio	01:01.3
Mean patient age	42.34
Range	5 – 90 Years

Table 3: Radiology + Histology + Operative Findings

	CT	US	Operative	Histology
Appendicitis	82	17	80	101
Perforated	12	0	17	0
Mild inflammation	2	0	7	15
No Inflammation	2	7	3	5
Gangrene	0	0	18	3
Miscellaneous	5	0	2	3

Table 4: Sensitivity & Specificity

Sensitivity & Specificity of Imaging		
	Total	Percentage
Scan accurately diagnosed	99	77.95%
Histology	101	79.95%
False negative	4	3.14%
Sensitivity		96
Specificity		80

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1.5. Sensitivity and Specificity

US:

Sensitivity:

0.6

Specificity

0.8

CT:

Sensitivity

0.95

Specificity

0.2 (**Table 4**)

Most admissions were in the young age group between 05-45 years, significant relation was reported between normal appendix and age groups male 16 -35 years and female 11 – 45 years, Appendicetomy rate was highest in the month of August 2018 (12.08%) and reach its lowest in April 2019 to be (4.39%). While, negative appendicetomy rate was most common in November 2018 (21.87%) and the minimum rate was zero during September 2018 and April 2019. Histopathological examination showed 32 cases (11.72 %) without Acute inflammation, 13 cases (4.76%) with mild inflammation. Faecolith 12 cases (4.39%), Parasites in 2 cases (0.73%), Fibrous obliteration in 2 cases (0.73%) Tumor in 1 case (0.36%).

2. Discussion

The assessment of patients with suspected appendicitis is driven by the goal of identifying all patients presenting with acute appendicitis as early in their clinical course as possible while minimizing the Laparoscopy/laparotomy rate. The dilemma in the clinical diagnosis of acute appendicitis is to balance diagnostic accuracy with appendiceal perforation. Missed diagnosis of appendicitis, especially when perforated, can result in severely adverse patient outcomes, while non therapeutic operations incur morbidity without treating the underlying condition. There is inconsistency regarding the management of an unexpected "normal appendix" during diagnostic laparoscopy [3-4].Centers with the most accurate diagnosis 89% have a higher rate of appendiceal perforation (29%), and vice versa, presumably due to earlier operation. The medical profession has gained much experience in managing patients with acute appendicitis ever since Fitz's first reported in 1886 [5]. Imaging studies in patients with a clinical suspicion of acute appendicitis can reduce the negative appendectomy rate, which has been reported to be as high as 15%. Most commonly used are ultrasonography, abdominal computed tomography (CT) and magnetic resonance imaging (MRI). Ultrasonography is rapid, inexpensive avoids radiation and is non-invasive requires no patient preparation or contrast administration, [6-9] can be performed at bedside with a sensitivity rate between 71 and 94 % and a specificity rate between 81 and 98 %. The positive likelihood ratio of ultrasonography is high at values between 6 and 46, while the negative likelihood ratio is moderate (0.08–0.30) [10-19]. Rates of indeterminate exams are high, with 50 to 85 percent of normal appendices not visualized [20, 21].

In our study Ultrasonography has a sensitivity of 0.6 and specificity of 0.8 Ultrasonography is reliable to confirm presence of appendicitis but unreliable to exclude appendicitis. Moreover, one would bear in mind that ultrasonography is highly operator dependent. Inconclusive ultrasonography findings, mainly due to failure imagining the appendix, mandate further image studies. Computed tomography Abdomen (CT) for suspected appendicitis has sensitivity and specificity rates between 76-100% and 83–100 %, respectively, positive predictive values of 92%-98%, and negative predictive values of 95%-98% for the diagnosis of acute appendicitis [6, 22, 24] and, therefore, is superior to ultrasonography. Lower values of sensitivity and specificity can be explained by the use of enteral contrast [25-27, 27-34] though; the radiation exposure of abdominal CT is a concern particularly in children and during pregnancy.

In our study Sensitivity of CT is 0.95 and specificity of 0.2.

MRI is associated with significant costs, and interpreting the images requires experience and is used in pregnant patients and children with unconvincing findings at ultrasonography [35]. A meta-analysis on MRI in 363 patients with appendicitis conceded a sensitivity rate of 97 % [95 % CI 92–99 %], a specificity rate of 95 % [95 % CI 94–99 %], a positive likelihood ratio of 16.3 [95 % CI 9.10–29.10] and a negative likelihood ratio of 0.09 [95 % CI 0.04–0.20]. [36]These rates are comparable to those of CT imaging, although these findings should be interpreted with care as most studies have been performed in a selected group of patients.

Several studies supported medical imaging; mainly computed tomography (CT) and ultrasonography scan, for management of acute appendicitis. The dilemma in the clinical diagnosis of acute appendicitis is to balance diagnostic accuracy with appendiceal perforation. Our study was designed to audit the experience of managing patients with suspected acute appendicitis by the conventional approach. Combining history, physical examination, appropriate imagings with laboratory tests are crucial to this. If the result was not satisfactory when compared to other centers, a protocol ultrasonography and/

or scan CT (as advocated by some) would be instituted and a prospective audit conducted.Precise history and physical exam are important to prevent unnecessary surgery and avoid complications. The possibility of appendicitis depends on patient age, clinical setting, and symptoms [37-38]. Radiological investigations should be done only in patients in whom a clinical and laboratorial diagnosis of appendicitis cannot be made. While literature had proven the significance of diagnostic imaging, our study did support the same, and we found that, CT, US is significant in relation to negative appendicetomy. Variation in performing imaging study for Acute Appendicitis through initial assessment might be due to various factors, such as preference of institution, availability of equipment, expertise, and the alleged need for diagnosis confirmation. Imaging and laboratory findings are very helpful in early diagnosis of Acute Appendicitis if atypical presentation were noticed. Studies demonstrated that preoperative imaging corresponds with reductions in the Negative Appendicetomy Rate, and the increased concerns are over diagnostic errors; highly recommend use of US, CT, while establishing Acute Appendicitis as the diagnosis. However, we consider that low use of diagnostic imaging is the risk factor that exposes patients to Negative Appendicetomy.

3. Conclusion

- Imaging is key in optimizing outcomes in appendicitis, not only as an aid in early diagnosis, but potentially reducing negative appendectomy rates
- Scans should be interpreted within the clinical context

Protocols on the routine use of imaging may need to be investigated and standardized.

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