



Ultrasonogram in Acute Appendicitis, A Surgeon's Perspective: Original Article

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Authors' contributions

This work was carried out in collaboration among all authors. Author AV designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors RC and RB managed the analyses of the study. Author KS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: The diagnosis of acute appendicitis has essentially been clinical, but USG abdomen has been said to be highly accurate in diagnosing AA. The surgeon's perspective may not always be the same.

Materials and methods: Appendectomy data of 106 patients from two hospitals of Kangra region was retrospectively analysed. The data was collected for age, sex, initial pre-operative diagnosis, USG findings, intra-operative findings, Histo-pathological examination (HPE) report, post operative hospital stay.

Observations: It revealed a sensitivity of about 54% and specificity of 100% for diagnosing AA with the help of USG abdomen. AA was seen most commonly in males as compared to females. Mean age of presentation was 29.34 +/- 14.4 years. Mean hospital stay was 3.68 +/- 2.25 days. Most common initial preoperative diagnosis was AA (84%). Most common position of the appendix during surgery was retrocecal (53.7%). HPE report revealed AA in 105 patients.

Conclusion: USG abdomen is often falsely assuring, leading to unnecessary delay in effectively managing a patient of AA further leading to increased complications. Only the clinically equivocal cases require further radiological investigations where CECT abdomen is the preferred investigation, but it should be used judiciously.

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1. INTRODUCTION

Acute appendicitis (AA) is the most common surgical emergency, and Appendectomy is the most commonly performed emergency surgery worldwide [1,2]. It is the acute inflammation of appendix which if ignored can lead to serious complications and may even cause death. The prevalence of AA has been found to be about 7% in the general population [1]. Traditionally the diagnosis of AA has been by clinical examination incorporating the signs and symptoms along with laboratory investigations, thus leading to the clinical scoring systems like Alvarado Score [2]. The negative appendectomy rate (NAR) was high and it had been agreed that a NAR of about 15% was acceptable in order to prevent morbidity and mortality due to a perforated appendix [3]. With the passage of time radiological investigations especially Ultrasonogram (USG), Contrast Enhanced Computerised Tomogram (CECT) and Magnetic Resonance Imaging (MRI) of the abdomen became the preferred modalities for diagnosing AA, especially in women and children. USG abdomen is non invasive easily available, cheap, reproducible and does not subject the patients to radiation exposure like CECT does. So Graded Compression USG abdomen became the preferred modality for diagnosing AA. However it is highly operator dependent and requires a lot of skill and expertise to visualise an appendix on USG [4]. Literature is full of evidence that it has got high specificity, sensitivity, negative and positive predictive values [1]. But in clinical practise we note more often than usual, that either the appendix is not visualised or reported to be normal in the USG abdomen. What to do in such situations? If we wait then we risk perforation of appendix. If we proceed with surgery there are chances of a negative appendectomy or if we subject the patient to CECT abdomen we may risk significant radiation exposure. The surgical books mentioned for careful clinical re- evaluation from time to time without sending such patients home [1,2]. Recent studies have said that second USG abdomen should be done in the coming hours, and even CECT and MRI abdomen has been recommended as per American College of Radiology [5]. But is it worth waiting and risking the appendicular gangrene and perforation? Thus this study was conducted so as to assess the role of USG abdomen in the diagnosis of AA.

2. MATERIALS AND METHODS

This was a retrospective study involving the two prominent hospitals of the Kangra region in Himachal Pradesh. We retrospectively analysed the Appendectomy data of Zonal Hospital Dharamsala (ZHD) and a single unit of Department of Surgery at Dr. RP Government Medical College (DRPGMC), Kangra at Tanda, from December 2015 to June 2016. 63 patients were from ZHD and 43 patients were operated at DRPGMC making a total of 106 patients. The patients were examined initially by the Emergency Room (ER) physicians and then by the surgeons on duty. All the patients of acute abdomen with clinical diagnosis of AA were included and subjected to USG abdomen followed by surgery. The patients were operated by 05 different surgeons on different occasions, according to the emergency duty rosters of the Department of Surgery. The patient data collected was: Age, sex, initial preoperative diagnosis, USG findings, intraoperative findings, position of appendix, hospital stay, and histopathological diagnosis. The data was statistically analysed using SPS software. For statistical analysis only, the cases where USG abdomen showed appendicular abscess, ruptured appendix, and appendicular lump were clubbed with patients where USG abdomen showed AA. The cases reported as, appendix not visualised and ileocecal mass were grouped along with patients having no evidence of appendicitis, as negative for appendicitis on USG abdomen.

3. RESULTS AND OBSERVATIONS

In this study 49 (46.2%) patients were females and 57 (53.8%) patients were males. The mean age of the patients was 29.34 +/- 14.4 years, although it ranged between 2 and 70 years (Fig.1).

The most common initial pre-operative diagnosis was Acute Appendicitis seen in 89 (84%) patients, followed by right renal pain in 8 (7.5%) patients. 03 patients presented with acute cholecystitis and 02 with acute gastritis. 01 patient each presented with the features of appendicular lump, perforated appendix, urinary tract infection (UTI) and acute generalised peritonitis (Fig. 2).

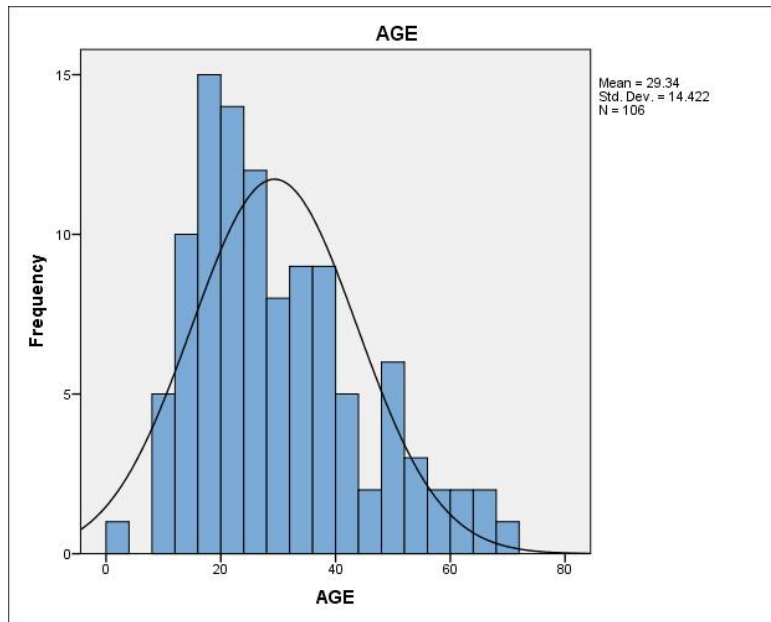


Fig. 1. Showing age distribution

USG abdomen was suggestive of AA in 50 (47.2%) patients. In 47 (43.4%) patients there was no sonological evidence of AA. In 01 patient the appendix was not visualised. Appendicular lump was reported in 05 patients. The other findings were appendicular abscess, ruptured appendix, and ileo cecal mass in one patients each (Table 1).

followed by pelvic in 36 (34%), paracecal in 8 (7.5%), post ileal in 3(2.8%), preileal and sub cecal in one patient each (Fig.3).

The histopathological diagnosis of acute appendicitis was confirmed in 105 patients.01 patient had normal appendix on histopathological examination (Table 2).

During surgery the position of appendix was found to be retrocecal in 57 (52.8%) patients,

The mean hospital stay was 3.68 +/- 2.25 days and it ranged between 1 and 17 days. (Fig. 4).

Table 1. Usg abdomen findings

Usg findings	Frequency(N)	Percentage (%)
Acute appendicitis	50	47.2
Appendicular abscess	1	0.9
Appendicular lump	5	4.7
Appendix not visualised	1	0.9
Ileocecal mass	1	0.9
No e/o appendicitis	47	43.4
Ruptured appendix	1	0.9
Total	106	100

Table.2. Usg finding * histopathological report crosstabulation

		Histopathological Report		Total
		Acute Appendicitis	No Appendicitis	
USG FINDING	Ac. Appendicitis	57	0	57
	No e/o Appendicitis	48	1	49
Total		105	1	106

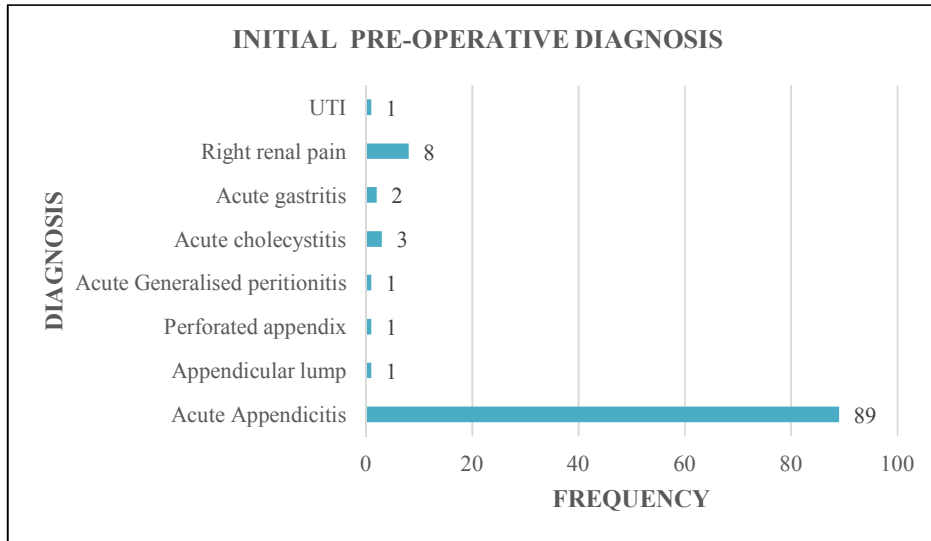


Fig. 2. Showing the initial pre-operative diagnosis

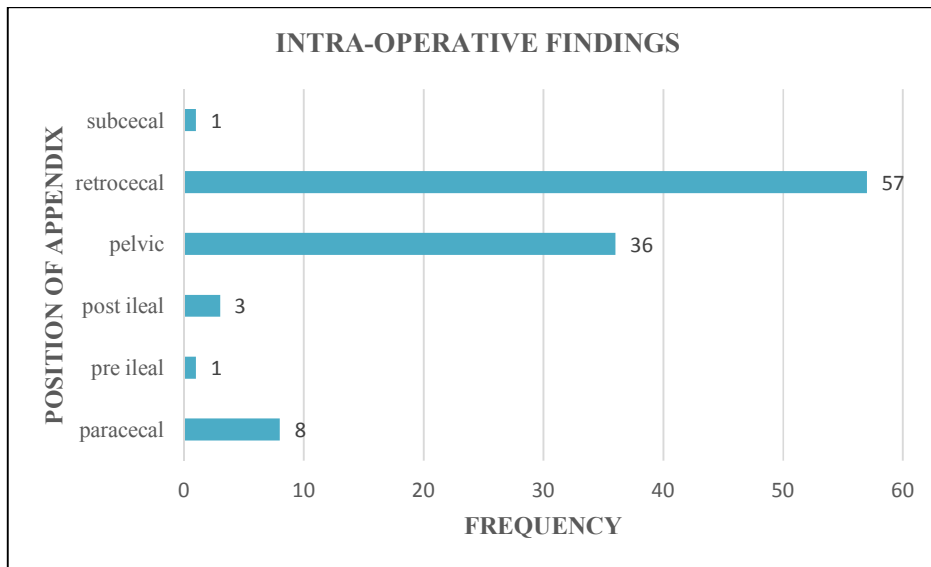


Fig. 3. Showing the intra-operative findings

4. DISCUSSION

Emergency Appendectomy is the most commonly performed surgery worldwide and is still the “Gold Standard” treatment of Acute Appendicitis (AA)[1-3]. Although no age or sex is exempt from AA , however , it is more commonly seen in males as compared to females ,from second to fourth decade of life. In our study the mean age of presentation was 29.34 +/- 14.4 years. The male: female ratio was 1.16:1. Berger DH [1] reported the mean age of presentation to

be 33 years and male: female ratio to be 1.2 to 1.3:1. Appendix is a part of the caecum which has lagged behind during the development of the gut. Differential development of caecum is responsible for different positions of the appendix. These different positions of appendix are responsible for different clinical manifestations it causes when inflamed. Most common position of the appendix is Retrocecal (74%) followed by Pelvic, Paracecal, Subcecal, Preileal and Postileal [2]. Similarly in our study the most common position of appendix was

Retrocecal (52.8%) followed by Pelvic position in around 32% patients. The typical features of Acute appendicitis are a history of migration of pain to right iliac fossa, nausea, vomiting, fever, and anorexia especially in children. Anorexia is the first symptom of appendicitis in 95% of the patients followed by pain abdomen and vomiting [1]. But this history may not be same in every case. Children present with features of generalised peritonitis and septicemia at an early stage since the omentum is not fully developed which could otherwise localise the disease spread. The different positions of appendix further complicate the picture. Tenderness in the right iliac fossa may not be seen in Retrocecal appendicitis, rather it may cause lumbar pain and may be confused with renal pain. APelvic appendicitis can present with diarrhoea or urinary tract infection. Preileal appendicitis can mimic acute intestinal obstruction. The differential diagnosis may be difficult. It may be confused with Meckel's diverticulitis, gastroenteritis, gastritis or intussusception. Obesity makes it difficult to elicit the clinical signs of tenderness. Old age patients may present with gangrenous appendicitis. AA in pregnant females may lead to foetal loss. Other important differential diagnosis in females are torsion of ovary, Pelvic inflammatory disease (PID), Mittelschmerz and ruptured ectopic pregnancy. These are the situations where an USG of abdomen can help in

ruling out the causes of pain in the right iliac fossa [2]. The advantages of USG are , it is non-invasive, easily available, affordable, poses no radiation hazard, no exposure to any ionic contrast material, is easily reproducible and it is said to have a high sensitivity and specificity. But only in 25-29% of the patients USG can provide an alternative diagnosis whenever a patient suspected of AA is subjected to USG examination [6]. In our study patients presented to the ER with the initial preoperative diagnosis of AA in 84 % patients while about 16% patients had other initial diagnosis of acute cholecystitis, UTI, gastritis, renal pain, appendicular lump, acute generalised peritonitis, and ruptured appendix. Subsequently the USG abdomen was done in every patient and revealed AA in 50 (47%) patients only. The reported sensitivity of ultrasound for diagnosing acute appendicitis ranges from 55%- 96% whereas it's specificity ranges from 85%- 98% [1]. In a study from England, D'souza et al. [7] reported that ultrasound could visualise appendix in 55% of the patients only. They reported a sensitivity of 51.8 % and a specificity of about 81.4%. We found the sensitivity of 54.29% (44.28%- 64.04%, CI 95%) and a specificity of 100% (2.50%- 100%, CI 95%), for the diagnosis of AA with USG abdomen. Presently, Graded compression ultrasound is the recommended sonological technique [4]. A non compressible

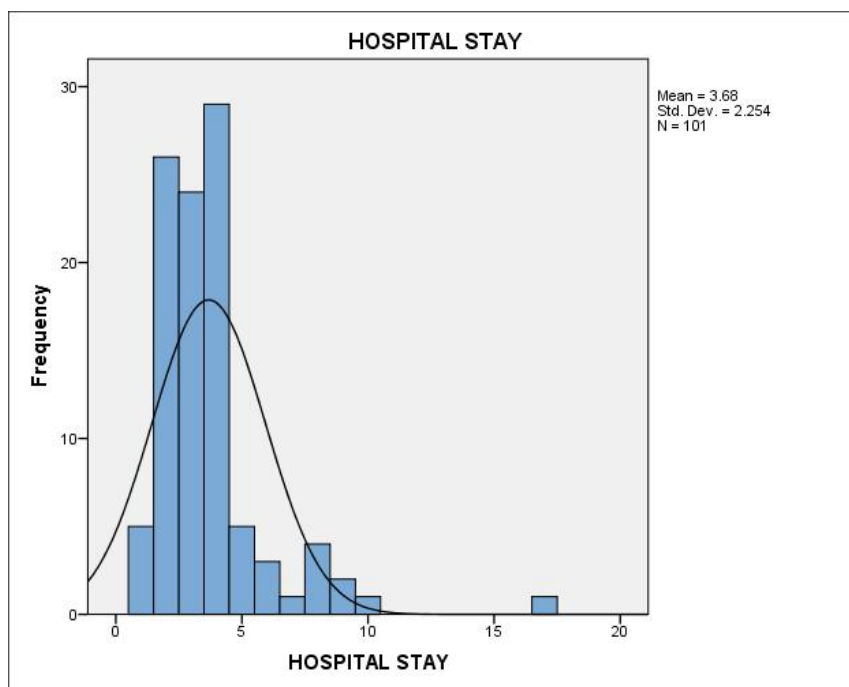


Fig. 4. Showing the hospital stay

aperistaltic, appendix with an antero posterior diameter of more than 6 mm (millimeter) is diagnostic of AA. A fecolith may be seen inside the appendicular lumen. Periappendiceal fluid and the thickening of appendicular wall are indirect evidences of acute appendicitis. The biggest drawback of ultrasound is, it's operator dependence [1,2,5,8,9]. Generally, In every hospital the junior residents are dealing with this situation initially. Whenever an USG abdomen is done for suspected patient of AA from the ER, it is usually the residents who are performing the initial USG .Since we are getting more and more dependent on investigations, may be for the fear of litigation, or the work load of patients, or rarely the patient preferences; the toll it takes on ER teams is evident . Frequently the utrasonograms are reported as 'Appendix not visualised' or 'no evidence of Acute Appendicitis' [7,10]. To rule out AA, it must be visualised in its whole length to say that it is normal. A non visualised appendix does not mean there is no AA because may be the sonologist was not able to see the appendix in its entire length. Only the part of Appendix may be normal while the tip may be inflamed. As the most common position of tip of appendix is retrocaecal in about 74% patients, it is further difficult to see the appendix behind the gas filled, stool laden, paralysed gut loops during inflammation [2,10] .Garcia Penna et a.l [11] visualised a normal appendix 2.4% times using USG and 84% of the times using CECT abdomen. Likewise, a normal appendix was visualised in 6% using USG and in 12% using CECT of the abdomen by Kaiser et al [12]. The graded compression ultrasound was thought to be the answer but to do a graded compression ultrasound it requires a great deal of time and expertise which may not be the case always. Inspissated stools can look like an appendicolith, the tubal pathologies in females can mimic dilated appendix, furthermore compressibility of appendix may be difficult to elicit in obese patients thus producing false positive results on ultrasound abdomen. Contrary to this, a perforated appendix may be compressible and Retrocecal appendix may not be visible due to overlying gases and may produce false negative results on ultrasound scan of abdomen for AA. Further an anxious patient may not allow the examination for the fear of pain, especially a crying child. The drawback of this is usually a sonogram being reported as "Appendix not visualised" or "no evidence of Acute Appendicitis" [10,13]. In such situations the patients as well as surgeons prefer to wait and watch sometimes ignoring the need for surgery. The analgesics

and antibiotics may suppress the initial symptoms which may or may not resolve. And if they don't, an appendix may perforate and further increase the troubles, both short term as well as long term. In a survey, the American surgeons were found to prefer CECT of abdomen while European surgeons were in favour of diagnostic laparocopy for investigating a young patient with nonspecific cause of acute abdomen initially, especially in females [14]. No offence to anyone, but most of data available on the internet describing the role of USG in diagnosing AA, is by Radiologists but the Surgeon's perspective may not always be the same [3-6,9-12]. D'souza et al. [7] said that the published evidence looks good on paper in favour of USG in AA, but in reality it is different. USG is not able to visualise the appendix about 45% of the times. Even the radiologists seem to differ on the utility of USG in diagnosing AA. Kaiser et al[12] in a randomised controlled trial consisting of 600 patients suspected of acute appendicitis found that USG was correct in diagnosing AA 22% of the time, while CECT was correct 78% of the times. Pinto et al [15] in their review of literature have found the highly variable diagnostic accuracy of USG abdomen in diagnosing AA. They found the sensitivities ranging from 44%- 100% and the specificities ranging from 47%- 100% for diagnosing AA with the help of USG abdomen. So how could a test, which has got such a wide range of sensitivity and specificity, be considered a diagnostic test? CECT of the abdomen is better as compared to USG in diagnosing AA, but there is always a risk of cancer induced by radiation exposure [1,2]. Neilsen JW et al. [16] found that the universal application of CECT abdomen in diagnosing acute appendicitis will prevent 12 unnecessary appendectomies but could result in one additional cancer death. Schulman et al [10] concluded that imaging in acute appendicitis should be an adjunct to,not instead of, the physical examination and it is required in patients with equivocal physical examination. No imaging is required in patients having a clinical diagnosis of acute appendicitis or no appendicitis. Douglas et al. [17] said that, A patient having a negative sonology results in presence of clinical suspicion of appendicitis cannot be discharged, but should be kept under observation and frequently examined for worsening or improvement of symptoms. Alvarado Score is a clinical scoring system widely used in management of AA patients. It makes use of clinical symptoms, signs and laboratory investigations. A modification in Alvarado score has been made to drop out the

shift of neutrophil count to the left, as this is not possible everywhere due to laboratory limitations [18]. Shukla et al. [19] has found clinical accumen to be better in diagnosing AA and perforated appendix. Soldo et al. [20] al have concluded that the clinical examination in combination with laboratory findings is good enough to rule in favour of Acute Appendicitis. Five patients in our study were having appendicular lump. They all had appendectomy without any post operative complications. Management of appendicular lump has traditionally been conservative i.e. Ochsner Sherren regimen, with delayed surgery after 6-10 weeks when the inflammation is thought to settle down and it's easy to operate without any significant morbidity to the patient.[21] Exception to this rule was a rapidly progressing mass, deteriorating patient condition, or development of features of peritonitis. But with the latest studies showing that it is easy to operate upon the patient with an appendicular lump at an early stage, this belief is being challenged. Demetrashvili et al. [22] said that emergency appendectomy as well as initial conservative management of appendicular lump followed by delayed surgery have the same results. Chandra Pandey et al. [23] found that early surgical exploration confirmed the diagnosis and cured the problem. It reduced the cost of management, shortened the convalescence and hospital stay with reasonably satisfactory outcome. Bhumika P et al. [24] drew the same conclusion from their study of 598 patients of AA admitted to their hospital. Similarly Mohamed A et al. [8] concluded that early surgical intervention is an effective alternate to conservative management in appendicular lump. The mean hospital stay in our study was 3.68 +/- 2.25 days, which ranged from 1- 17 days. The 17 day hospital stay was seen in a patient who presented with ruptured appendix. After appendectomy she developed surgical site infection which was managed conservatively.

5. LIMITATIONS OF STUDY

The limitation of our study was that it was a retrospective study. The sample size of the study was small. BMI was not taken into consideration.

6. CONCLUSION

Appendix may be too small an organ to be noticed sometimes, but it can cause too big a problem to ignore. USG abdomen is often falsely reassuring, leading to unnecessary delay in effectively managing a patient of Acute

Appendicitis further causing increased complications. Only the clinically equivocal cases require further radiological investigations where CECT abdomen is the preferred investigation, but it should be used judiciously.

CONSENT

Written informed consent was obtained from the patients. A copy of the written consent is available for review by the Editor-in-Chief of this journal. Since it was a retrospective study and did not jeopardise the personal identities of the individuals involved, no ethical clearance was required.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Jaffe BM, Berger DH. The Appendix. In: Schwartz SI and Brunicaudi CF (Eds.), Schwartz Principles of Surgery. (9th edn.), McGraw-Hill Health Pub. Division, New York, USA. 2010;2043-2083.
2. Mulsow J. The vermiform appendix. In Bailey & Love's; short practice of surgery 27th edition, CRC press London. 2008; 1299-1367.
3. Shogilev DJ, Duus N, Odom SR, Shapiro NI. Diagnosing appendicitis: evidence-based review of the diagnostic approach in 2014. West J Emerg Med. 2014;15:859–871.
4. Puylaert JB. Acute appendicitis: US evaluation using graded compression. Radiology. 1986;161:691–695.
5. Smith MP, Katz DS, Lalani T, Carucci LR, Cash BD, Kim DH, et al. ACR appropriateness criteria right lower quadrant pain--suspected appendicitis. Ultrasound Q. 2015;31(2):85-91.[Medline].
6. Lowe LH, Perez R Jr, Scheker LE, Stein SM, Heller RM, Schulman MH. Appendicitis and alternate diagnoses in children: findings on unenhanced limited helical CT. Pediatr Radiol. 2001;31(8):569–577.
7. D' Souza N, D' Souza C, Grant D, Royston E, Farouk M. The value of ultrasonography in the diagnosis of appendicitis.

- International Journal of Surgery. 2015; 13(2015):165-169.
8. Mohamed A, Bhat N. Acute Appendicitis Dilemma of Diagnosis and Management. The Internet Journal of Surgery. 2009; 23(2).
 9. Pacharn P, Ying J, Linam LE, Brody AS, Babcock DS. Sonography in the Evaluation of Acute Appendicitis ,Are Negative Sonographic Findings Good Enough? J Ultrasound Med. 2010;29: 1749–1755.
 10. Schulman MH. CT and US in the Diagnosis of Appendicitis: An Argument for CT Radiology 2010;255:3–7. Available:10.1148/radiol.09091211
 11. Garcia Peña BM, Mandl KD, Kraus SJ, et al . Ultrasonography and limited computed tomography in the diagnosis and management of appendicitis in children. JAMA. 1999;282(11):1041–1046.
 12. Kaiser S, Frenckner B, Jorulf HK. Suspected appendicitis in children: US and CT—a prospective randomized study. Radiology. 2002;223(3):633–638.
 13. Khan U, Kitar M, Krichen I, Maazoun K, Althobaiti RA, Khalif M, Adwani M. To determine validity of ultrasound in predicting acute appendicitis among children keeping histopathology as gold standard. Annals of Medicine and Surgery. 2019;38:22–27. Available:https://doi.org/10.1016/j.amsu.2018.11.019
 14. Jaunoo SS, et al. An international survey of opinion regarding investigation of possible appendicitis and laparoscopic management of a macroscopically normal appendix, Ann. R. Coll. Surg. Engl. 2012; 94(7):476e480.
 15. Pinto F, Pinto A, Russo A et al. Accuracy of ultrasonography in the diagnosis of acute appendicitis in adult patients: review of the literature. Crit Ultrasound J. 2013; 5(Suppl 1):S2.
 16. Nielsen JW, et al. Reducing computed tomography scans for appendicitis by introduction of a standardized and validated ultrasonography report template, J. Pediatr. Surg. 2015;50(1):144–148.
 17. Douglas CD, MacPherson NE, Davidson DM, Gani JS: Randomized controlled trial of ultrasonography in diagnosis of acute appendicitis incorporating Alvarado's Score. BMJ. 2000;321:919
 18. Kalan M, Talbot D, Cunliffe WJ, Rich AJ: Evaluation of the modified Alvarado score in the diagnosis of acute appendicitis: a prospective study. Ann R Coll Surg Engl. 1994;76:418-9.
 19. Shukla A, Bharti R, Chaudhary R, Sharma M. Diagnostic value of Plain Abdominal Radiograph, Ultrasonography and Clinical impression of the surgeon in acute peritonitis. Ann. of Int. Med. & Den. Res. 2015;1(2):66-71.
 20. Soldo I, Biljak VR, Bakula B, Bakula M , Simundic M. The diagnostic accuracy of clinical and laboratory parameters in the diagnosis of acute appendicitis in the adult emergency department population - a case control pilot study Biochem Med (Zagreb). 2018;28(3):030712. Doi:10.11613/BM.2018.030712. PMID:PMC6214693
 21. Ochsner AJ. The cause of diffuse peritonitis complicating appendicitis, and its prevention. JAMA. 1901;26:1747-54.
 22. Kim JK, Ryoo S, Oh HK , Kim JS, Shin R, Choe EK, Jeong SY, Park KJ. Management of Appendicitis Presenting with Abscess or Mass. J Korean soc coloproctol. 2010;26(6):413-419. DOI: 10.3393/jksc.2010.26.6.413
 23. Pandey CP, Kesharwani RC, Chauhan CG, Pandey MK, Mittra P, Kumar P, et al. Management of appendicular lump: Early exploration vs conservative management. Int J Med Sci Public Health. 2013;2:1067-1070. DOI: 10.5455/ijmsph.2013.230820131
 24. Patel BJ, Patel KH. A comparative study of appendicular lump management. Int Surg J. 2015;2:235-8. DOI: 10.5455/2349-2902.isj20150521

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