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Research Article

A Comparative Study of Computed Tomography Vs Ultrasonography in Evaluation of Right Iliac Fossa Mass

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Abstract

Introduction: Right Iliac Fossa (RIF) Mass is a clinical diagnosis with multiple differential diagnoses. Thus, the importance of accurate diagnosis in this clinical condition is of apex importance as there is no blanket treatment for all the conditions producing RIF mass.

Materials and Methods: This prospective study of patients with RIF mass is carried out between January 2017 to September 2020 with a total of 301 cases. This study was carried out at Kempegowda Institute of Medical Sciences and Research Centre, Bangalore, India.

The inclusion criteria:

1) Patient more than 15 years.
2) Any patient admitted with RIF mass or any patient found to have RIF mass after admission and investigation provided a minimum of 3 out of 5 clinicians with not less than 5 yrs of clinical experience have felt presence of RIF mass in the patient after through clinical examination.

The exclusion criteria being:

1) Patients refusing to give consent,
2) Patients who underwent Ultrasonography/CT scan elsewhere before presentation to our hospital,
3) All patients with gynecological conditions presenting as RIF mass,
4) Mass encroaching onto RIF from other region and parietal wall swellings in RIF,
5) Patients not fit to undergo Contrast Enhanced CT due to allergy/ renal failure.

Conclusion: USG is an economical, non-invasive, patient friendly procedure done in OPD set up without any preparation, without any exposure to radiation with good results is an ideal first line investigation in pre-operative evaluation of RIF mass. However, in case of patients with RIF mass CT scan must be the diagnostic modality of choice as it is far superior to USG in diagnosing various individual conditions with high sensitivity and specificity. Thus, the authors advocate the use of USG in suspected emergency conditions presenting with RIF mass as the diagnostic modality of choice and CECT in preoperative evaluation of RIF mass in patients who does not require emergency intervention.

Keywords: Computed Tomography; Ultrasonography; Right Iliac Fossa Mass

Introduction

Right Iliac Fossa (RIF) Mass is a clinical diagnosis with multiple differential diagnoses. The need for prompt and accurate diagnosis arises in this clinical scenario as these differential diagnoses are spread over a wide spectrum ranging from a simple appendicular mass to a carcinoma of caecum or ascending colon. Multiple clinical entities can present with the same symptom of mass in right lower abdomen and the spectrum of treatment for these conditions also varies on similar lines ranging from emergency surgery in intussusception to conservative management in abdominal tuberculosis. Thus, the importance of accurate diagnosis in this clinical condition is of apex importance as there is no blanket treatment for all the conditions producing RIF mass.

Until a decade ago ultrasonography was the main stay for diagnosis of RIF mass. The sensitivity and specificity of ultrasonography (USG) in differentiating various conditions causing RIF mass and its role in the preoperative evaluation of RIF mass has been considered satisfactory by multiple studies [1-4]. However, in recent times Computed Tomography (CT) has widely replaced Ultrasonography as the preferred diagnostic tool in this condition. The main question this study answers is that "Is Computed Tomography really required in evaluation of all cases of RIF mass?" It is to be noted that there are no considerable studies proving the efficacy of CT scan over ultrasonography in diagnosing individual conditions causing RIF mass.

Aim of the Study

The present study aims at statistically comparing the efficacy of ultrasonography and CT in individual conditions presenting with RIF mass. This is necessary as in a possible scenario of both diagnostic tools having similar efficacy then ultrasonography will be the superior modality in view of low cost, no radiation hazard, easy availability, no need of patient preparation or blood investigations and less time required. The present study is carried out by comparing the sonological diagnosis and CT diagnosis with final diagnosis in each condition, gauge the sensitivity and specificity and compare the statistical significance of each modality in the given condition. The study also takes into account the efficacy of both the modalities in identifying conditions requiring surgery from those that can be managed conservatively and also efficacy in identifying conditions requiring emergency intervention.

Materials and Methods

This prospective study of patients with RIF mass is carried out between January 2017 to September 2020 with a total of 301 cases. This study was carried out at Kempegowda Institute of Medical Sciences and Research Centre, Bangalore, India. The study was approved by ethical committee of the hospital and was carried out under the supervision of the committee. The study was conducted with written informed consent from the patient after clearly explaining him/her the radiation hazard associated with CT scan, need for contrast injection and the complications associated with it and need to perform both the diagnostic modalities on them.

The inclusion criteria for recruiting cases in this study were:

1) Patient more than 15 years.
2) Any patient admitted with RIF mass or any patient found to have RIF mass after admission and investigation provided a minimum of 3 out of 5 clinicians with not less than 5yrs of clinical experience have felt presence of RIF mass in the patient after through clinical examination.

The exclusion criteria being:

1) Patients refusing to give consent.
2) Patients who underwent Ultrasonography/ CT scan elsewhere before presentation to our hospital.
3) All patients with gynecological conditions presenting as RIF mass.
4) Mass encroaching onto RIF from other region and parietal wall swellings in RIF.
5) Patients not fit to undergo Contrast Enhanced CT due to allergy/renal failure.

A total of 526 eligible patients were identified in the study period, however 225 of the patients were not included as they satisfied one or more of the exclusion criteria. The case was taken up for study on admission and after obtaining written consent and after explaining them nature of surgery if required, type of anesthesia and the study being done. Detailed clinical history was taken and all cases underwent thorough physical examination. Routine investigations were done for all cases and depending on the provisional diagnosis the following specific investigations and treatment plans were followed (Table 1 and 2).

Provisional diagnosis	USG findings	CT findings
Appendicular mass	Echo poor, Heterogeneous Texture, Probe tenderness.	Threshold appendicular diameter of 15 mm, clumping of bowel loops in RIF giving appearance of a well-defined heterogeneously enhancing mass lesion, bowel loops appear thickened and edematous, surrounding mesenteric inflammatory changes [8].
Appendicular Abscess	Hypo echoic, para-caecal fluid collection.	Appendix replaced by Phlegmon/ Abscess, assc mural thickening of adjacent distal ileum and caecum, Ill-defined hypo-dense collection with rim enhancement [9].
Ileo-Caecal TB	Hypo echogenic mass with echogenic center with pseudo kidney sign with thickening of bowel wall.	Thickening of IC valve, disproportionate thickening of caecum, peri-caecal lymphadenopathy, pulled caecum, ascites [10].
Carcinoma Caecum	Irregular bowel wall thickening leading to target sign in caecum.	Well defined hypodense heterogeneously enhancing caecal wall thickening with areas of hypodensities s/o necrosis, causing moderate to significant luminal narrowing with surrounding fat stranding [11].
Psoas Abscess	Thick walled fluid collection in psoas muscle extending into pelvis [5].	Fluid filled collections located in the retro fascial space rather than retroperitoneal space, with thick enhancing capsular wall [12].
Iliac Lymphadenopathy	Iliac Hypo echoic and heterogeneous lymph nodes with sonolucency and peri nodal echogenicity along iliac vessels [6].	Well defined Non enhancing hypo dense lesions > 7 mm in the internal iliac group, and > 10 mm in the external iliac group [13], Benign lymphadenopathy shows smooth margins, while malignant showing irregular contour [14].
Intussusception	Target sign, crescent in a donut sign and pseudo kidney sign [7].	Bowel-within-bowel configuration, in which the layers of the bowel are duplicated forming concentric rings, when imaged at right angles to lumen, and a soft tissue sausage when imaged longitudinally, alternate rim of hypo and hyper density [15].

Table 1: USG findings, CT findings in different conditions of RIF mass.

Provisional diagnosis	Specific investigation	Management plan
Appendicular mass	HPE of Appendix	Conservative Management + Interval Appendectomy
Appendicular Abscess	HPE of Appendix	Emergency Appendectomy
Ileo-Caecal TB	Sputum for AFB, Colonoscopy and HPE, Quantiferon Gold Test for TB, Stool for occult blood.	Conservative Management, Surgery if needed
Carcinoma Caecum	Colonoscopy, Stool for occult blood, HPE	Right Hemi colectomy or Limited Ileo-Caecal resection
Psoas Abscess	Pus Culture and sensitivity	Incision and Drainage/ Pig tail catheter incision/ Guided Aspiration
Iliac Lymphadenopathy	USG Guided Biopsy and HPE examination	Conservative Management
Intussusception	Intraoperative Finding	Emergency Laparotomy and release of Intussusception.

Table 2: Investigations done and plan of management in different cases of RIF mass.

In cases of Appendicular mass and appendicular abscess the cause of appendicular inflammation is not considered irrespective of it being an appendicolith or an appendicular tumor as this fact is inconsequential to the study. Appendicular Mass is defined as an inflamed appendix with an adherent covering of omentum and small bowel. The history is similar to that of appendicitis with a longer duration since onset. Examination reveals a mass in the right iliac fossa [16].

A 5 - 7.5 MHz linear array transducer was used in our study with graded compression technique. This technique displaces the bowel loops and compresses the caecum and facilitates good sonological view of the RIF. All the ultrasonographic examinations were done by a single experienced radiologist and his opinion was considered final. After the specific intervention or investigation a final diagnosis was obtained and the provisional diagnosis (on USG) and the final diagnosis were compared.

The CT Machine used in this study is 16 slice Helical CT, GE Bright Speed machine. The contrast used was Iopamidol Injection USP at 2 ml/kg with Iopamidol USP 61.24g, Trimethamine USP 100 mg, EDTA USP 33 mg, Hydrochloric Acid q.s to p.h = 6.9 - 7.1, Water for Injection I.P. q.s.a 100 ml.

Statistical methods

Chi-Square and Fisher Exact tests were used along with diagnostic statistics like sensitivity; specificity positive predictive value and negative predictive value were used. Statistical software namely SAS 9.2, MedCalc 9.0.1 and Systat 12.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

Results

A total of 301 cases were studied in this series. The cases were divided according to their final diagnosis and the comparison of final and ultrasonographic and CT diagnosis has been done. The distribution of cases as per the final diagnosis is as shown in table 3.

Out of 301 patients studied 237 were operable cases (Conditions considered operable being appendicular mass, appendicular abscess, carcinoma caecum, psoas abscess and intussusception). Ultrasonography was able to diagnose 227 out of the 237 (Sensitivity of 95.78%) as operable cases and the remaining Ten were inconclusive report. However, ultrasonography was able to identify 68 of the 69 cases requiring emergency intervention with 98.5% sensitivity (Conditions like Appendicular abscess, psoas abscess and intussusception were considered as conditions requiring emergency intervention). The final diagnosis correlated with sonological diagnosis in 279 cases with sensitivity of 92.69%.

Final Diagnosis	No of Cases	Percentage
Appendicular Mass	156	51.82%
Appendicular Abscess	60	19.99%
Ileo-Caecal TB	56	18.60%
Carcinoma Caecum	12	3.98%
Psoas Abscess	8	2.65%
Iliac Lymphadenopathy	8	2.65%
Intussusception	1	0.33%

Table 3: Distribution of the disease based on final diagnosis (C.I= 95% Confidence interval of the proportion).

The most common conditions being appendicular mass followed by appendicular abscess and ileocaecal TB. The following table (Table 4) shows the diagnosis on ultrasonography and number of cases.

Ultrasonographical diagnosis	Number of Cases	Percentage
Appendicular Mass	150	49.83% [C.I = 44.21 - 55.79%]
Appendicular Abscess	59	19.60% [C.I = 15.42 - 24.72%]
Ileo-Caecal TB	47	15.61% [C.I = 12.73 - 21.48%]
Carcinoma Caecum	9	2.99% [C.I = 1.07 - 4.91%]
Psoas Abscess	8	2.65% [C.I = 1.25 - 5.39%]
Iliac Lymphadenopathy	5	1.66% [C.I = 0.8 - 4.5%]
Intussusception	1	0.3% [C.I = 0.012 - 2.12%]
Inconclusive study	22	7.30% [C.I = 4.36 - 10.24%]

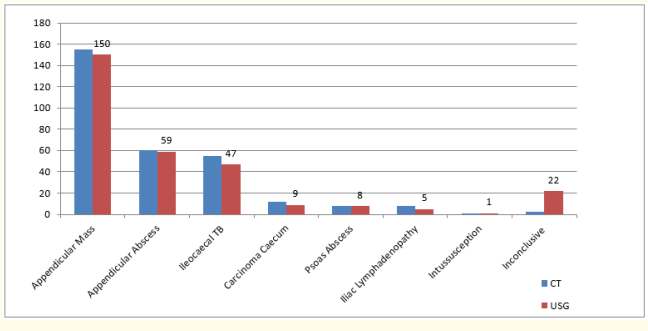
Table 4: Distribution of disease based on ultrasonography (C.I = 95% Confidence interval of the proportion).

One case diagnosed to be appendicular abscess on USG was found to be appendicular mass intra-operatively and one case of appendicular mass underwent emergency appendectomy due to worsening clinical features.

On the other hand on Computed Tomography of the 301 patient who underwent scanning only 2 cases were reported as inconclusive report. Of the 237 operable cases 236 were diagnosed correctly with CT scan with sensitivity of 99.5%. Computed Tomography was able to diagnose all 69 cases requiring emergency intervention with 100% sensitivity and specificity. The following table (Table 5) shows the CT Diagnosis and the number of cases.

CT diagnosis	Number of Cases	Percentage
Appendicular Mass	155	51.49% [C.I = 45.84 - 57.14%]
Appendicular Abscess	60	19.99% [C.I = 15.47 - 24.51%]
Ileo-Caecal TB	55	18.27% [C.I = 13.9 - 22.64%]
Carcinoma Caecum	12	3.98% [C.I = 1.77 - 6.19%]
Psoas Abscess	8	2.65% [C.I = 1.25 - 5.39%]
Iliac Lymphadenopathy	8	2.65% [C.I = 1.25 - 5.39%]
Intussusception	1	0.3% [C.I = 0.012 - 2.12%]
Inconclusive study	2	0.66% [C.I = 0.012 - 2.12%]

Table 5: Distribution of disease based on computed tomography (C.I = 95% Confidence interval of the proportion).



Graph 1: Comparison of diagnosis on CT scan and ultrasonography.

Discussion

The results of this study have been compared to Millard FC., *et al*. [4], the observations are almost similar except that there has been improved sensitivity and specificity of USG in differentiating appendicular pathology and in diagnosing the different conditions causing RIF mass and no of correct diagnoses has also improved possibly with expert hands and better equipment. However, the above mentioned study did not include computed tomography for comparison.

In the present study when compared to CT scan, ultrasonography is a quick and safe and a good first line diagnostic tool in case of mass in RIF. It has similar sensitivity as CT scan in diagnosing conditions requiring emergency intervention such as appendicular abscess, psoas abscess and intussusception. There is no statistical difference in between the two modalities in terms of detecting the above mentioned conditions. However, CT scan is marginally superior in differentiating operable conditions from non-operable conditions in cases presenting with RIF mass. The difference between the two modalities is statistically significant. The Sensitivity of the two modalities in the above said conditions is shown in table 6.

Condition	Sensitivity of USG	Sensitivity of CT Scan	P Value
Conditions requiring Emergency Intervention	98.33% [C.I = 95.09 - 100%]	100%	> 0.05
Operable Conditions	95.7% [C.I = 93.12 - 98.28%]	99.57% [C.I = 98.74 - 100%]	< 0.05

Table 6: Comparison of sensitivity of CT and USG in emergency conditions and operable conditions in RIF mass (C.I = 95% Confidence interval of the proportion).

However, in case of individual conditions of RIF mass CT scan is statistically superior in diagnosing conditions like Ileocaecal Tuberculosis, Carcinoma Caecum, and Iliac Lymphadenopathy etc. However, the efficacy of USG and CT is comparable in diagnosing conditions like appendicular pathology, psoas abscess and intussusception. Table 7 illustrates the various conditions and the sensitivity of each modality in the specific conditions.

Thus, USG is an economical, non-invasive, patient friendly procedure done in OPD set up without any preparation, without any exposure to radiation with good results is an ideal first line investigation in pre-operative evaluation of RIF mass. It effectively identifies all conditions requiring emergency intervention in patients with RIF mass and though not as good as CT but can identify operable cases with reasonable accuracy. Thus it can be the investigation of choice in emergency evaluation of RIF mass and in conditions where CT scan cannot be performed due to various reasons (renal failure etc.). Thus, the clinician can avoid loss of valuable time in investigation, increased exposure to radiation and unnecessary economic burden involved due to CT scan in conditions re-

quiring emergency intervention. And our experience showed that many patients with Appendicular abscess and psoas abscess have deranged Renal Function tests placing them at risk of renal failure following CECT.

Diagnosis	Sensitivity of USG	Sensitivity of CT Scan	P Value
Appendicular Mass	96.15% [C.I = 93.13% - 99.17%]	99.30% [C.I = 98.09% - 100%]	> 0.05
Appendicular Abscess	98.33% [C.I = 95.09 - 100%]	100%	> 0.05
Ileocaecal TB	89.28% [C.I = 74.3% - 93.54%]	98.21% [C.I = 94.74% - 100%]	< 0.05
Ca. Caecum	75% % [C.I = 50.5% - 99.5%]	100%	< 0.05
Psoas Abscess	100%	100%	> 0.05
Iliac Lymphadenopathy	62.5% [C.I = 28.95% - 96.05%]	100%	< 0.05
Intussusception	100%	100%	> 0.05

Table 7: Comparison of the sensitivity of CT scan and USG in various conditions with 95% C.I and its statistical significance.

However, in case of other patients with RIF mass CT scan must be the diagnostic modality of choice as it is far superior to USG in diagnosing various individual conditions with high sensitivity and specificity. Furthermore, the delineation of anatomy and three dimensional correlations of various organs with respect to the mass can be of immense help to the surgeon when operating a case of RIF mass. Moreover, the definitive diagnosis by CT scan can encourage the clinician to avoid various invasive investigative modalities that are otherwise required for the definitive diagnosis. Thus, the authors advocate the use of USG in suspected emergency conditions presenting with RIF mass as the diagnostic modality of choice and CECT in preoperative evaluation of RIF mass in patients who does not require emergency intervention. However, the observer dependent nature of USG has to be taken into account while interpreting the results as there is high scope for inter-observer variability in diagnosis by Ultrasonography.

Figure 1: Appendicular mass - Plain..

Figure 2: Appendicular mass - Contrast.

Figure 3: Intussusception plain.

Figure 4: Intussusception contrast.

Figure 5: Psoas abscess - Plain.

Figure 6: Psoas abscess - Contrast.

Conclusion

USG is an economical, non-invasive, patient friendly procedure done in OPD set up without any preparation, without any exposure to radiation with good results is an ideal first line investigation in pre-operative evaluation of RIF mass. However, in case of patients with RIF mass CT scan must be the diagnostic modality of choice as it is far superior to USG in diagnosing various individual conditions with high sensitivity and specificity. Thus, the authors advocate the use of USG in suspected emergency conditions presenting with RIF mass as the diagnostic modality of choice and CECT in preoperative evaluation of RIF mass in patients who does not require emergency intervention.

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Volume 2 Issue 8 August 2021